



HEALTH IMAGING

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THEORY GUIDE
for the
Kodak X-Omat MULTILOADER 7000
Service Code: 3444



Important

Qualified personnel must service this equipment.



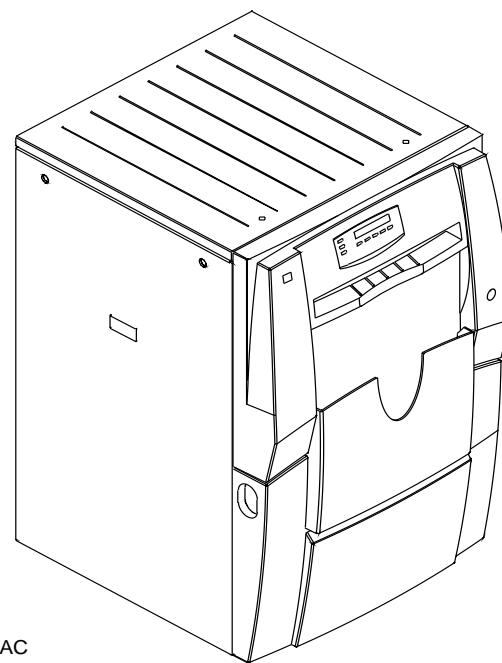
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This equipment includes parts and assemblies sensitive to damage from electrostatic discharge. Use caution to prevent damage during all service procedures.

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Section 1: Introduction

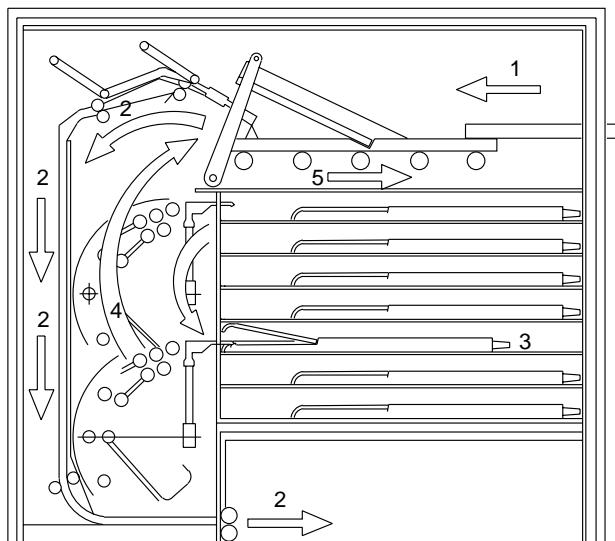
Product Description

The Kodak X-Omat MULTILOADER 7000 is a general purpose daylight handling system for radiographic sheet film. The MULTILOADER 7000 is a complete, compact system that removes sheet film from a CASSETTE, transports the film to the *Kodak X-Omat 3000 RA INTEGRATED PROCESSOR*, loads unexposed film into the CASSETTE, and returns the CASSETTE to the operator. All operations of the MULTILOADER 7000 are completed in daylight conditions without risk of exposure to the film.

The MULTILOADER 7000 handles and processes film from sizes 18 x 24 cm (7 x 9 in.) to 35 x 43 cm (14 x 17 in.). The MULTILOADER 7000 automatically determines the size of the film by measuring the size of the CASSETTE that is inserted. The operator can choose one of two types of film for each size CASSETTE. A reflective STICKER is placed on the CASSETTE to identify one type, and the absence of the STICKER identifies the other type. MAGAZINES are available to store seven different sizes or types of film at one time.

The default parameters are stored in memory and can be modified by the user. A BATTERY supplies uninterrupted power to memory. The parameters do not change when the operator de-energizes the MULTILOADER 7000.

Product Operation



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The MULTILOADER 7000 has several systems which work simultaneously to transport and manipulate CASSETTES, exposed and unexposed film, and MAGAZINES. Four separate MICROPROCESSORS control these systems.

All systems operate using MOTORS, pneumatic components such as SOLENOIDS, VALVES, and vacuum components. SENSORS, both mechanical and optical, provide feedback to the system. The mechanical operations are described below:

- [1] An operator inserts a CASSETTE containing one sheet of exposed patient film into the CASSETTE ENTRANCE. The MULTILOADER 7000 receives, centers, and determines the size of the CASSETTE. The CASSETTE OPENER opens the CASSETTE to allow for removal of the film.
- [2] The CASSETTE SUCKER BAR removes the film from the CASSETTE. The film transports through a CONVEYOR and FILM CHUTE, through the PROCESSOR INTERFACE, and into the PROCESSOR.

- [3] The MULTILOADER 7000 determines which MAGAZINE contains the size and type of film required, and the MAGAZINE SHUTTLE MECHANISM moves the chosen MAGAZINE into position. The MAGAZINE OPENER then opens the MAGAZINE.
- [4] The MAGAZINE SUCKER BAR extracts an unexposed sheet of film from the MAGAZINE, and pulls it into the FILM POCKET. The FILM POCKET then transports the film and inserts it into the CASSETTE.
- [5] The MULTILOADER 7000 closes the CASSETTE and pushes it out of the CASSETTE ENTRANCE for operator retrieval.

For a more detailed description of the Sequence of Operation, [see Page 9](#).

System Initialization

After the MULTILOADER 7000 initially energizes, each CONTROL UNIT completes its own independent initialization.

MAGAZINE SHUTTLE MECHANISM (MSM) CONTROL UNIT

For diagnostic and manufacturing purposes, the MSM CONTROL UNIT has multiple initialization procedures depending on the settings of the DIP SWITCHES. The following procedure is the standard initialization used for the normal operation of the MULTILOADER 7000 (DIP SWITCHES 1,2,5 are in the off setting). The MSM CONTROL UNIT:

- Initializes:
 - OUTPUT REGISTERS - de-energizes all outputs
 - SERIAL INTERFACE of the CPU
- Checks:
 - RAM
 - all SERIAL INTERFACES
- Tests the MOTOR CONTROLLERS and enables the outputs.
- Connects the LAPTOP COMPUTER to the BOARD A1.
- Checks the FLASH EPROM SOFTWARE.
- Alerts the main program and initializes variables.
- Sends a power-up message to the MAGAZINE CONTROL UNIT.
- Illuminates the OPERATING LED.

MAGAZINE CONTROL UNIT

The MAGAZINE CONTROL UNIT:

- Initializes:
 - OUTPUT REGISTERS - de-energizes all outputs
 - SERIAL INTERFACE of the CPU
- Checks:
 - RAM
 - BOOT: EPROM - This is a checksum test
 - FLASH: EPROM - This is a checksum test
 - FPGA is energized
- Alerts the main program.
- Initializes the variables and the RS232 INTERFACE to the MSM CONTROL UNIT.
- Waits for the power-up message from the MSM CONTROL UNIT.
- Sends a power-up message to the SYSTEM CONTROL UNIT. This message also includes data from the MSM CONTROL UNIT.
- Checks:
 - status of the MSM
 - FRONT DOOR is closed
 - MSM is in the home position
- Enters the command loop to receive and execute commands from the SYSTEM CONTROL UNIT and the MSM CONTROL UNIT.

CASSETTE CONTROL UNIT

The CASSETTE CONTROL UNIT:

- Tests if the FPGA is energized.
- Initializes:
 - OUTPUT REGISTERS - de-energizes all the outputs
 - SERIAL INTERFACE of the CPU
- Checks:
 - RAM
 - BOOT - EPROM
 - FLASH - EPROM
- Alerts the main program.
- initializes variables and sends a power-up message to the SYSTEM CONTROL UNIT.
- Enters the command loop to receive and execute commands from the SYSTEM CONTROL UNIT and the MSM CONTROL UNIT.

PROCESSOR

For details on the initialization of the PROCESSOR, [See “THEORY GUIDE for the Kodak X-Omat 3000 RA INTEGRATED PROCESSOR Service Code: 3466 in a Kodak X-Omat MULTILOADER 7000 Service Code: 3444.”](#), Part No. 3H9574.

SYSTEM CONTROL UNIT

The SYSTEM CONTROL UNIT then:

- Initializes:
 - CPU - including the CHIP SELECT, TIMER, and INTERRUPT REGISTERS
 - Outputs - de-energizes all the outputs
 - SERIAL INTERFACES to the CASSETTE UNIT, MAGAZINE UNIT, PROCESSOR and the LAPTOP COMPUTER
- Checks:
 - RAM
 - BOOT - EPROM
 - FLASH - EPROM
- Initializes:
 - interrupt vector table
 - multi-tasking executive
- Clears the COMMUNICATION BUFFER.
- Initializes the OPERATOR DISPLAY.
- Executes hardware tests:
 - back-up RAM
 - SERIAL INTERFACES
 - DISPLAY CONTROLLER
 - CLOCK CHIP
- Checks that the BOOT and FLASH SOFTWARE are compatible, and then alerts the main program.
- Starts the TASKS of the SYSTEM TASKS. For a description of the function of the TASKS, [see Page 44.](#)

- Waits for a power-up messages from the MAGAZINE CONTROL UNIT, CASSETTE CONTROL UNIT, and PROCESSOR.
- Sends parameters to CASSETTE CONTROL UNIT and MAGAZINE CONTROL UNIT.

Section 2: Sequence of Operation

Introduction

Once the MULTILOADER 7000 completes initialization and is ready for operation, it detects where the UNITS are and sends them to home position. The MULTILOADER 7000 ejects any film left inside and closes and ejects any CASSETTES that are inside. All MAGAZINES return to the home position against the front MAGAZINE DOOR.

The sequence and flowchart in this section show a normal cycle. Normal cycle means that a CASSETTE, with exposed film, feeds into the MULTILOADER 7000 and a filled MAGAZINE with the corresponding film size is available in the MULTILOADER 7000. Other cycles not included are: unload only, load only, empty CASSETTE/MAGAZINE, and serial unload.

This sequential cycle is not a totally accurate picture of the operation, because the MULTILOADER 7000 accomplishes many steps in parallel. Also, the time duration and the sequence of the steps change as the size of the film changes.

Sequence of a Normal Cycle

In the description of this sequence, the following assumptions are made:

- There is no film in the PROCESSOR
- The operator inserts an 18 x 24 mm (7 x 9 in.) CASSETTE with an exposed sheet of film inside
- The corresponding 18 x 24 mm (7 x 9 in.) unexposed film is in a MAGAZINE in level 1

[1] The operator feeds a CASSETTE into the CASSETTE ENTRANCE of the MULTILOADER 7000.

[2] CASSETTE REGISTRATION SENSOR B2 detects the CASSETTE and the MULTILOADER 7000 starts the following actions:

- The green READY LIGHT illuminates and the amber LIGHT illuminates. SENSOR B24 checks for the presence of a CASSETTE.
- ROLLERS transport the CASSETTE to the three CASSETTE END SENSORS B5, B6 and B7. At least two of the SENSORS must actuate to prove that the CASSETTE is straight and not skewed.
- The HOLDING FINGER MOTOR M3 energizes to bring the HOLDING FINGER fully into its home position. The FINGER measures the CASSETTE width.

Note

The CASSETTE OPENER MOTOR M5 only energizes if the CASSETTE SUCKER BAR is in the rear position, actuating the FILM PICK-UP REAR SENSOR B18. This is a safety precaution to avoid damage to the SUCKER BAR.

- The CASSETTE OPENER MOTOR M5 energizes to move the CASSETTE OPENER partially down. The pulses generated by the ODOMETER A10/3 determine the stop position of the OPENER. The counting of the pulses starts as soon as CASSETTE END SWITCH OPEN SENSOR B15 releases.

[3] MOTOR M1 energizes until the INPUT FLAP closes, and CASSETTE INPUT FLAP END SWITCH SENSOR B4 detects the INPUT FLAP.

[4] The MAGAZINE BLOWING SOLENOID Y11 energizes. The pressure line of the COMPRESSOR opens, because the COMPRESSOR cannot start when there is pressure in the pressure line.

[5] The COMPRESSOR M16 energizes early to build pressure in the pneumatic system.

[6] The MAGAZINE BLOWING SOLENOID VALVE Y11 de-energizes.

[7] CASSETTE centering begins. If CENTERING BARS END SWITCH OPEN SENSOR B10 does not detect the CENTERING BARS open, the CASSETTE CENTERING MOTOR M4 energizes to fully open the CENTERING BARS. The BARS must start in the open position because the closure of the BARS measures the CASSETTE. The CASSETTE CENTERING MOTOR M4 energizes until CASSETTE CENTERING LEFT/ RIGHT SENSORS B11 and B12 detect the CASSETTE. During this time the ODOMETER A10/2 generates count pulses to measure the length of the CASSETTE.

- [8] The HOLDING FINGER MOTOR M3 energizes and the HOLDING FINGER moves forwards and transports the CASSETTE fully to the CASSETTE END STOP. During this time the ODOMETER A10/2 generates count pulses to measure the width of the CASSETTE. MOTOR M3 de-energizes as soon as no more count pulses are generated, the FINGER stops at the CASSETTE, and all three CASSETTE END SWITCHES B5, B6, and B7 actuate. The MULTILoader 7000 checks that the INPUT FLAP closes, and sends the message "INPUT FLAP AND HOLDING FINGER ARE OK" to the SYSTEM UNIT.
- [9] After the CASSETTE centers, SENSORS detect the CASSETTE type 1 or 2. FILM TYPE 2 DETECTION SENSORS LEFT/RIGHT B21, and B22 check for the presence or absence of reflective STICKERS on the CASSETTE. The presence of at least one of the two STICKERS show the film is type 2, and the absence of both STICKERS show film type 1.
- [10] The FILM RELEASE in the FILM CHUTE closes, and the FILM RELEASE MOTOR M12 energizes until the FILM RELEASE CLOSED END SWITCH SENSOR B34 actuates. The SYSTEM UNIT receives the message "FILM RELEASE CLOSED".
- [11] The PROCESSOR INTERFACE STEPPER MOTOR M13 energizes.
- [12] The MULTILoader 7000 uses the CASSETTE size to select the correct MAGAZINE. The FILM POCKET moves to the appropriate MAGAZINE level, actuates SENSOR B32, and sends the command "MOVE AND OPEN MAGAZINE" to the MAGAZINE SHUTTLE MECHANISM.
- [13] The MAGAZINE SHUTTLE MECHANISM software selects the appropriate MAGAZINE, and energizes the ELECTRO-MAGNET adjacent to that MAGAZINE DRAWER. MOTOR M20 energizes, and the MAGNET BAR transports the DRAWER to the MAGAZINE POSITIONING BRACKETS. As the DRAWER nears the end position, the MAGAZINE TRANSPORT CLOSE TO FILM PICK-UP POSITION SENSOR B103 actuates and the MOTOR slows down. It then moves the MAGAZINE TRANSPORT slowly until the MAGAZINE TRANSPORT-AT-FILM-PICK-UP POSITION SENSOR B104 actuates. For a complete description of the MAGAZINE SHUTTLE MECHANISM, [see Page 17](#).
- [14] As soon as the MAGAZINE reaches the end position, the SOLENOID VALVE Y20 for the LOCKING CYLINDER actuates to check the position of the MAGAZINE. The SOLENOID VALVE then de-energizes the LOCKING CYLINDER so the MAGAZINE can be opened.
- [15] The MOTOR M21 energizes and drives the MAGAZINE OPENING BAR to lift the MAGAZINE COVER. SENSOR B106 actuates, and the SOLENOID VALVE energizes the LOCKING CYLINDER to lock the MAGAZINE in the correct position for film unload.
- [16] As soon as the FILM POCKET reaches the selected MAGAZINE level, it waits until the MAGAZINE DRAWER reaches the film unload position. Then it moves up until the FILM-POCKET-AT-MAGAZINE-LEVEL SENSOR B107 detects the metal TAB on the upper edge of the MAGAZINE DRAWER.
- [17] The INTERFACE FLAP MOTOR M11 energizes for a certain amount of time to open the FLAP. The SYSTEM UNIT receives the message "INTERFACE FLAP IS OPEN".

[18] MOTOR M5 energizes to open the CASSETTE.

- The CASSETTE OPENING MOTOR M5 energizes to move the CASSETTE OPENER down to its bottom position. The ODOMETER A10/3 counts 48 pulses to determine the bottom position.
- After the OPENER reaches the bottom position, the CASSETTE OPENER SOLENOID Y4 energizes.
- The CASSETTE BLOWING SOLENOID VALVE Y3 energizes.
- The CASSETTE OPENER MOTOR M5 energizes in reverse direction to lift the CASSETTE COVER. For large CASSETTES, it stops briefly to allow the vacuum to bleed off between CASSETTE SCREENS.
- After the OPENER reaches the blow position as determined by count pulses of the ODOMETER A10/3, the CASSETTE OPENER MOTOR M5 de-energizes.
- The BLOW PIPES blow air into the CASSETTE to separate the FILM from the LID SCREEN. The total blow time depends on the setting of the parameter blow time.
- The CASSETTE OPENER MOTOR M5 energizes again and the OPENER moves to the upper position, home position. MOTOR M5 de-energizes as soon as CASSETTE OPEN SENSOR B15 actuates. The CASSETTE OPENER SOLENOID Y4 de-energizes.
- CASSETTE REALLY OPEN SENSOR B16 detects the CASSETTE COVER and the SYSTEM UNIT receives the message "CASSETTE IS OPEN".

[19] The ROLLER MOTOR M7 in the CONVEYOR energizes.

[20] The MAGAZINE SUCKER BAR rotates into the MAGAZINE. MAGAZINE FILM PICK UP MOTOR M15 energizes. The FILM POCKET waits in the pick up position. The SUCKER BAR picks up the fresh film from the MAGAZINE after the exposed film is unloaded from the CASSETTE. The SYSTEM UNIT receives the message "FILM POCKET SUCKER BAR REACHED THE PICK UP POSITION".

[21] The SUCKER BAR picks the exposed film from the CASSETTE.

- The SOLENOID VALVES Y5 and Y6 energize to allow the vacuum to build up after the CASSETTE SUCKERS reach the film in the CASSETTE.
- The FILM PICK UP MOTOR M6 energizes. The CASSETTE SUCKER BAR CARRIAGE moves into the CASSETTE.
- 300 msec after the start of MOTOR M6, the SUCKER BAR TILTING SOLENOID Y7 energizes to tilt the CASSETTE SUCKER BAR.
- When FILM PICK UP END SWITCH FRONT SENSOR B17 actuates, the FILM PICK UP MOTOR M6 de-energizes, and sets a TIMER for 500 msec.
- The SOLENOID Y7 de-energizes, and the CASSETTE SUCKER BAR tilts back to separate the film from the CASSETTE SCREEN. The SYSTEM checks SUCKER BAR TILT SENSOR B19.
- The FILM PICK UP MOTOR M6 energizes in the reverse direction.
- The CASSETTE SUCKER BAR ASSEMBLY retracts from the CASSETTE.
- The VACUUM OFF SENSOR B20 detects the film, and sets the VACUUM OFF timer.
- At the end of the vacuum off time the SOLENOID VALVES Y5 and Y6 de-energize to vent the vacuum system. The CASSETTE SUCKER BAR releases the film and the CONVEYOR FRONT ROLLERS transport the film to the FILM CHUTE.
- After FILM PICK UP END SWITCH REAR SENSOR B18 actuates, the FILM PICK UP MOTOR M6 de-energizes.
- After VACUUM OFF SENSOR B20 detects the trailing edge of the film, the SYSTEM UNIT receives the message "FILM OUT OF THE CASSETTE".

[22] The MAGAZINE SUCKER BAR picks a fresh film from the MAGAZINE. This activity begins after SENSOR B20 senses the leading edge of the film plus a time delay. In the case of film transport problems in the FILM CONVEYOR, the CASSETTE and the film in the FILM POCKET eject from the CASSETTE ENTRANCE.

- The MAGAZINE BLOWING SOLENOID VALVE Y11 energizes, and the MAGAZINE BLOW PIPES blow air to separate the top sheet of film in the MAGAZINE.
- The MAGAZINE SUCKING SOLENOID VALVE Y12 energizes to create a build up of vacuum after the MAGAZINE SUCKER BAR reaches the top film in the MAGAZINE.
- The SOLENOID Y14 energizes to tilt the MAGAZINE SUCKER BAR.
- The STEPPER MOTOR FILM POCKET M10 energizes to move the FILM POCKET towards the film stack.
- The FILM POCKET SUCKER BAR reaches the film and actuates FILM AT SUCKER BAR SENSOR B61.
- The FILM POCKET moves further down the additional steps to ensure that the SUCKERS are in good contact with the film and a strong vacuum can be achieved.
- The STEPPER MOTOR FILM POCKET M10 de-energizes.
- The MULTILOADER 7000 checks if the MAGAZINE is nearly empty.
- After a pause of 100 msec the FILM POCKET MOTOR M10 energizes until the tilt position is reached.
- The FILM POCKET MOTOR M10 de-energizes.
- The SOLENOID Y14 de-energizes.
- After 50 msec the SOLENOID VALVE Y11 de-energizes, and the BLOW PIPES stop blowing air into the MAGAZINE.
- After a pause of 100 msec the DOUBLE SHEET DETECTION SOLENOID Y15 energizes, and the DOUBLE SHEET DETECTOR moves forward to measure the film thickness.
- After 200 msec SOLENOID Y15 de-energizes, and the MAGAZINE EMPTY SENSOR B60 checks for no film.
- The MOTOR FILM POCKET M10 energizes to move the FILM POCKET into the move-out position, and then de-energizes.
- The SYSTEM CONTROL UNIT receives the message "FILM POCKET SUCKER BAR REACHED THE MOVE OUT POSITION".

[23] The INTERFACE FLAP MOTOR M11 energizes to close the INTERFACE FLAP. When INTERFACE FLAP CLOSED END SWITCH SENSOR B33 actuates, MOTOR M11 de-energizes. The SYSTEM UNIT receives the message "INTERFACE FLAP IS CLOSED".

[24] The FILM POCKET SUCKER BAR with the fresh film rotates out of the MAGAZINE.

- MAGAZINE FILM PICK UP MOTOR M15 energizes.
- FILM PICK UP END SWITCH REAR SENSOR B58 detects the SUCKER BAR, and MOTOR M15 de-energizes.
- The SYSTEM UNIT receives the message "FILM POCKET SUCKER BAR REACHED THE REAR POSITION".

[25] The FILM POCKET transports the film to the CASSETTE level. The MULTILOADER 7000 calculates the required distance and sends the correct number of pulses to STEPPER MOTOR FILM POCKET M10. MAGAZINE LEVELS SENSOR B32 also monitors the distance between the level of the MAGAZINE and the level of the CASSETTE. The STEPPER MOTOR M10 de-energizes when the FILM POCKET reaches the level of the CASSETTE.

[26] The OPENER BAR closes the MAGAZINE, and the MAGAZINE SHUTTLE MECHANISM returns it to the home position.

- [27] The FILM POCKET SUCKER BAR rotates into the open CASSETTE.
- MOTOR M15 energizes until SENSOR B56 actuates.
 - MOTOR M15 de-energizes.
 - The SYSTEM UNIT receives the message "FILM POCKET SUCKER BAR REACHED THE FRONT POSITION".
- [28] The FILM POCKET moves down until the BLOW PIPES touch the LIGHT LOCK of the CASSETTE to keep the film from floating out of the CASSETTE. This setting is made in the PARAMETER LOWER POCKET.
- The STEPPER MOTOR FILM POCKET M10 energizes for the desired amount of pulses.
 - The SYSTEM UNIT receives the message "FILM POCKET IS LOWERED".
- [29] The SUCKER BARS blow the film off.
- The MAGAZINE BLOW SUCKER SOLENOID VALVE Y10 energizes for 200 msec to free the film from the SUCKERS. This may repeat up to 10 times (1 sec blow 0.5 sec pause) until FILM AT SUCKER BAR SENSOR B61 detects the film is not on the SUCKER BARS.
 - The SYSTEM UNIT receives the message "FILM IS BLOWN OFF FROM THE FILM POCKET SUCKER BAR SUCKERS".
- [30] The COMPRESSOR M16 de-energizes.
- [31] The FILM POCKET SUCKER BAR must be raised before it can be rotated out of the CASSETTE. STEPPER MOTOR FILM POCKET MOTOR M10 energizes to raise the SUCKER BAR until the MAGAZINE LEVEL SENSOR B32 detects the CASSETTE LEVEL BRACKET. The SYSTEM UNIT receives the message "FILM POCKET REACHED THE MOVE OUT POSITION".
- [32] The FILM POCKET SUCKER BAR rotates to the MIDDLE POSITION. MAGAZINE FILM PICK UP MOTOR M15 energizes until FILM PICK UP MIDDLE POSITION SENSOR B57 no longer detects the bracket. The SYSTEM UNIT receives the message "FILM POCKET SUCKER BAR REACHED THE MIDDLE POSITION".
- [33] The MULTILoader 7000 checks that the MAGAZINES are really closed. The SYSTEM UNIT receives the message "MAGAZINE COVERS ARE CLOSED".
- [34] The SOLENOID VALVES Y10 and Y11 energize to vent the pressure system.
- [35] The PROCESSOR INTERFACE transports the exposed film to the PROCESSOR. FILM IN INTERFACE BOTTOM SENSOR B35 detects the trailing edge of the film. The SYSTEM UNIT receives the message "FILM TRAILING EDGE IS RECOGNISED IN THE FILM CHUTE".
- [36] The CASSETTE OPENER MOTOR M5 energizes to close the CASSETTE. ODOMETER A10/3 measures the distance after the CASSETTE OPENER de-actuates SENSOR B15. After a pause of 100 msec MOTOR M5 energizes to remove the CASSETTE OPENER from the CASSETTE. MOTOR M5 de-energizes as soon as SENSOR B15 detects the CASSETTE OPENER in the upper position. The SYSTEM UNIT receives the message "CASSETTE IS CLOSED".
- [37] CASSETTE INPUT FLAP MOTOR M1 energizes until the INPUT FLAP opens. CASSETTE INPUT FLAP END SWITCH OPEN SENSOR B3 detects the INPUT FLAP opened.
- [38] The FILM RELEASE in the FILM CHUTE closes. FILM RELEASE MOTOR M12 energizes until SENSOR B34 actuates. The SYSTEM UNIT receives the message "FILM RELEASE IS CLOSED".
- [39] The FILM POCKET moves to MAGAZINE LEVEL 4. The STEPPER MOTOR FILM POCKET M10 receives the calculated amount of pulses to move the FILM POCKET from the CASSETTE LEVEL to MAGAZINE LEVEL 4. MAGAZINE LEVELS SENSOR B32 detects the correct level. The SYSTEM UNIT receives the message "FILM POCKET REACHED THE SELECTED LEVEL". The FILM POCKET then moves to the home position.
- [40] The SOLENOID VALVES Y10 and Y11 de-energize and venting of the pressure system ends.

- [41] The HOLDING FINGER MOTOR M3 energizes in reverse. The MULTILOADER 7000 monitors pulses from the ODOMETER A10/1. When the HOLDING FINGER stops at the mechanical end stop, the ODOMETER A10/1 stops generating pulses. This is the stop condition for MOTOR M3. The SYSTEM UNIT receives the message "HOLDING FINGER MOVED BACKWARD AND STOPPED AT THE END STOP".
- [42] The MULTILOADER 7000 checks that the FILM POCKET is in the home position. The FILM POCKET must be in home position and the status of the following SENSORS must be:

MAGAZINE OPEN END SWITCH B106	OFF
MAGAZINE CLOSED END SWITCH B105	ON
FILM PICK UP END SWITCH FRONT B56	OFF
FILM PICK UP MIDDLE SWITCH	OFF
FILM PICK UP END SWITCH REAR	ON

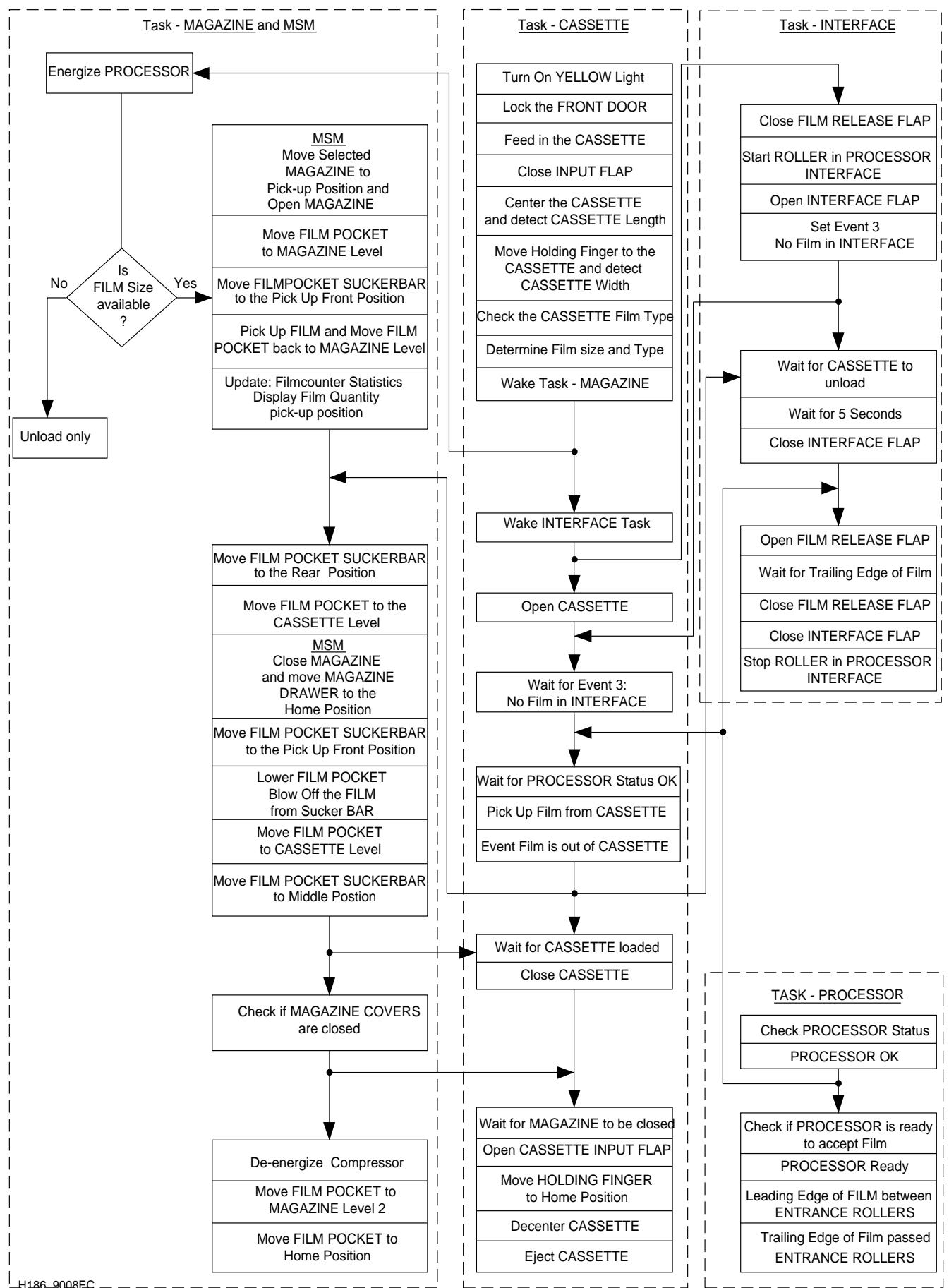
- [43] The SYSTEM UNIT receives the message "MAGAZINE UNIT IN HOME POSITION".
- [44] The MULTILOADER 7000 ejects the CASSETTE. The CASSETTE INPUT MOTOR M2 energizes and the CASSETTE ejects out of the MULTILOADER 7000. CASSETTE REGISTRATION SENSOR B2 detects the CASSETTE and MOTOR M2 de-energizes.
- [45] After a pause the PROCESSOR INTERFACE STEPPER MOTOR M13 de-energizes.
- [46] The segmented INTERFACE ROLLERS send a signal to the PROCESSOR that a film is coming.
- [47] When the operator removes the CASSETTE, CASSETTE REGISTRATION SENSOR B2 de-actuates and the green READY LIGHT illuminates at the OPERATOR CONTROL PANEL. The MULTILOADER 7000 can start a new cycle.
- [48] In standby, the MULTILOADER 7000 checks to see if the CASSETTE UNIT and the MAGAZINE UNIT are in home position.

Flow Chart

The sequence of events differs slightly from cycle to cycle, because four independent MICROPROCESSORS work in parallel (SYSTEM CONTROL UNIT, CASSETTE CONTROL UNIT, MSM CONTROL UNIT, and MAGAZINE CONTROL UNIT). The events described here are from a normal cycle without errors.

The following chart is a simplified illustration of a normal cycle. Normal cycle means that a CASSETTE with an exposed film feeds into the MULTILOADER 7000 and a MAGAZINE with the corresponding film size is in the MULTILOADER 7000. This is not a description of an unload only, load only, empty CASSETTE/MAGAZINE or serial unload cycle. This is also a simplified description of the software sequences.

The flow chart on the next page shows the MAGAZINE, CASSETTE, INTERFACE, and PROCESSOR and the basic interaction between those tasks. The chart shows the simultaneous actions of some of the operations.



Section 3: Systems and Components

Mechanical Systems

The MULTILOADER 7000 consists of several electro/mechanical systems that operate simultaneously. These systems are all housed in a large stainless steel FRAME, and controlled by three MICROPROCESSORS. The MICROPROCESSORS interact during each cycle to perform the desired operations.

Mechanical components such as ROLLERS, CYLINDERS, and GEARS operate with MOTORS, pneumatic components and vacuum operated components. Mechanical and optical SENSORS provide feedback to the MICROPROCESSORS.

The primary systems of the MULTILOADER 7000 remain the same as the *Kodak X-Omat* MULTILOADER 300. The main difference between the two is that the MULTILOADER 7000 allows for seven MAGAZINES that each hold a different size or type of film, and the MULTILOADER 300 only allows for three MAGAZINES.

To save space in the MULTILOADER 7000, the seven MAGAZINES are stacked tightly together and the MAGAZINE SHUTTLE MECHANISM moves the desired MAGAZINE out of the stack for opening and removal of film. In the MULTILOADER 300, the MAGAZINES remain stationary and open in place.

Each MAGAZINE has a new system for sensing film size and type. Six SENSORS detect the presence or absence of six different reflective STICKERS. Each film size and type has a code based on the six STICKERS.

The primary systems of the MULTILOADER 7000 are:

CASSETTE ENTRANCE SYSTEM

The CASSETTE ENTRANCE is the opening through which the CASSETTE enters and exits the MULTILOADER 7000. The operator inserts the CASSETTE into the CASSETTE ENTRANCE, a SENSOR detects the CASSETTE, and the INPUT FLAP closes to make the MULTILOADER 7000 light tight. At the completion of the cycle, the FLAP opens and the CASSETTE ejects from the MULTILOADER 7000.

The CASSETTE ENTRANCE consists of one pair of ROLLERS, a SENSOR ASSEMBLY to detect CASSETTES and an INPUT FLAP to close the ENTRANCE.

CASSETTE TRANSPORT SYSTEM

The CASSETTE TRANSPORT SYSTEM moves the CASSETTE to the correct position, aligns it for opening, and measures the size of the CASSETTE. After the MULTILOADER 7000 loads the CASSETTE with fresh film at the end of the cycle, the CASSETTE TRANSPORT ejects the CASSETTE from the MULTILOADER 7000.

The CASSETTE TRANSPORT consists of:

- A ROLLER TRANSPORT MECHANISM for feeding the CASSETTE in and out.
- A holding FINGER to move the CASSETTE close to the mechanical END STOP, and to measure the width.
- Two CENTERING BARS to move the CASSETTE in a centered position between left and right and to measure the CASSETTE Length.

CASSETTE OPENER SYSTEM

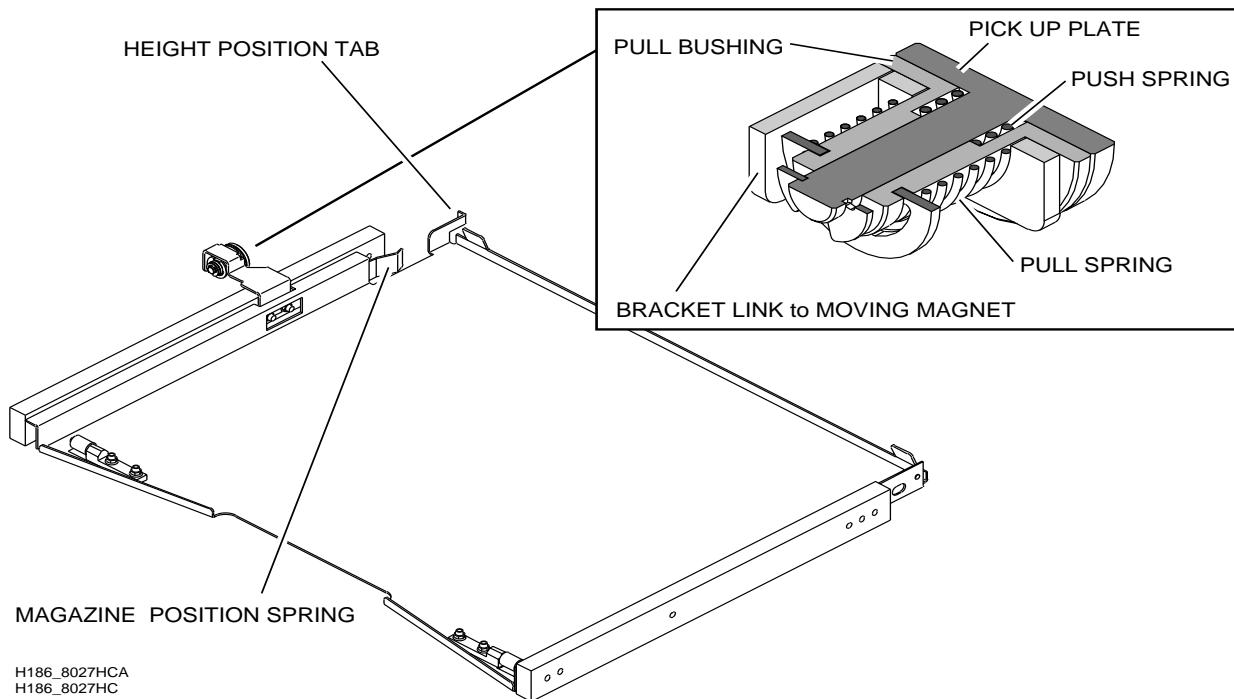
The CASSETTE OPENER opens and closes the CASSETTE. It consists of an OPENER BAR with a moveable OPENER WEDGE and two moveable HOOKS.

CONVEYOR SYSTEM

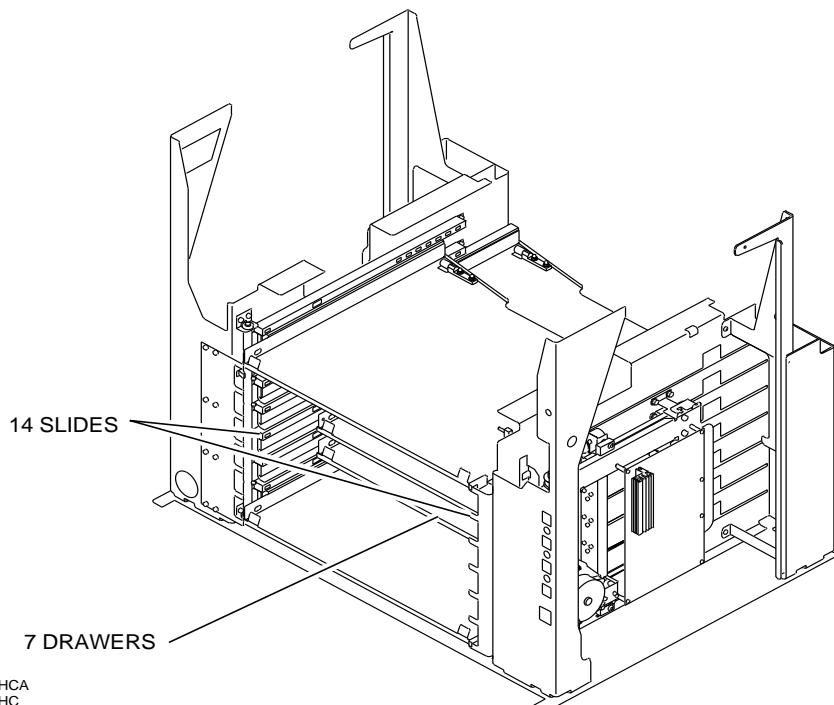
The CONVEYOR removes the exposed film from the CASSETTE and transports the film to the FILM CHUTE. A SUCKER BAR CARRIAGE removes the film from the CASSETTE and places it into the ROLLER TRANSPORT MECHANISM that transports the film to the FILM CHUTE.

MAGAZINE SHUTTLE MECHANISM SYSTEM

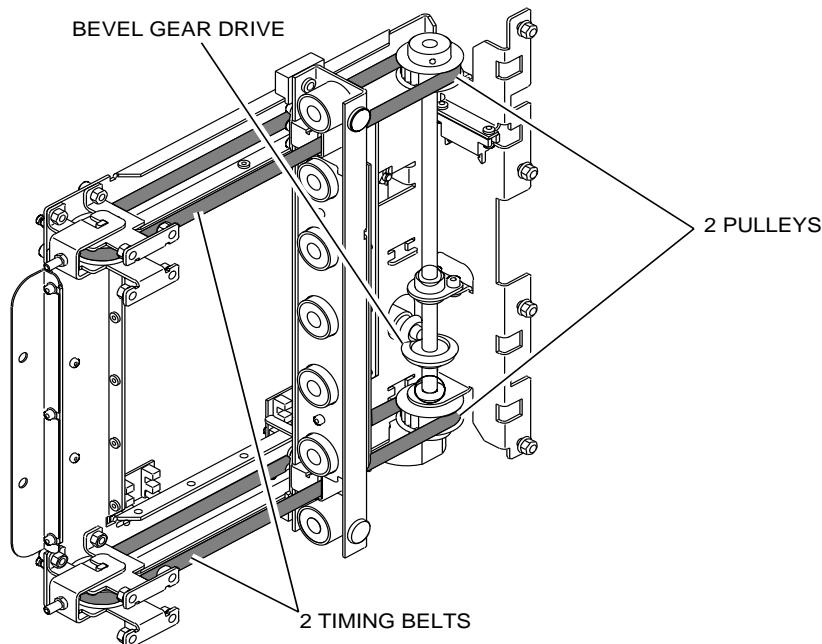
The MAGAZINE SHUTTLE MECHANISM is a new system in the MULTILOADER 7000. Since seven MAGAZINES now take the place of three MAGAZINES in the previous MULTILOADER 300, the MULTILOADER 7000 has a new MECHANISM for transporting and storing MAGAZINES.



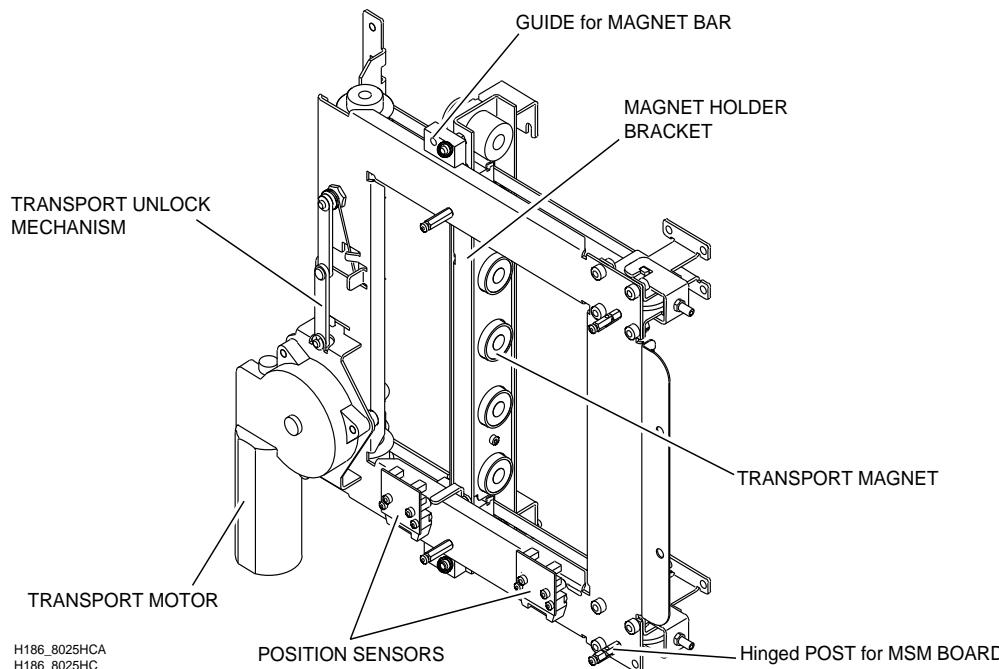
Seven film DRAWERS hold the seven MAGAZINES. A BRACKET extending some distance from the DRAWER provides a link to the MAGNET which moves the selected film DRAWER.



The seven DRAWERS each ride to the pick-up position on two extendable SLIDES. The SLIDES also allow the operator to pull the film DRAWER from the MULTILOADER 7000 for MAGAZINE replacement. When the DRAWERS are pulled from the MULTILOADER 7000, the SLIDES lock in position. The operator must unlock the SLIDES before returning the DRAWERS to the home position.

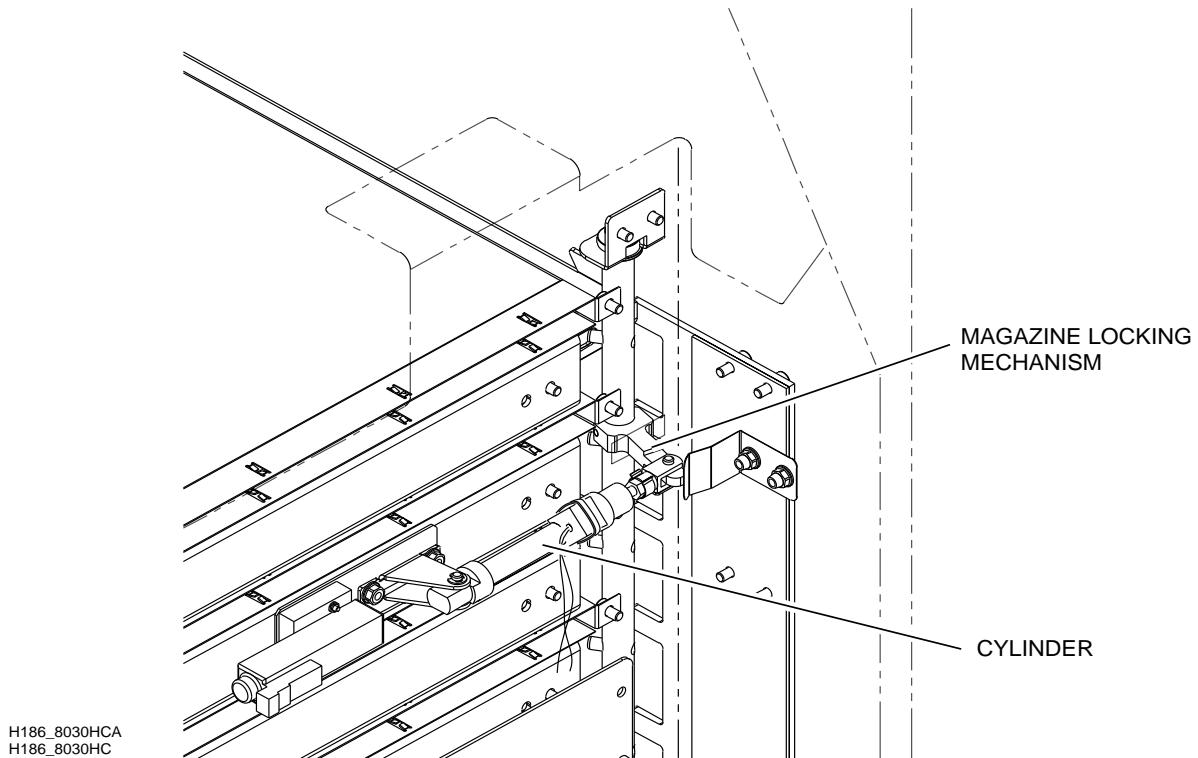
Rear View of MAGAZINE SHUTTLE MECHANISM

H186_8026HCA
H186_8026HC

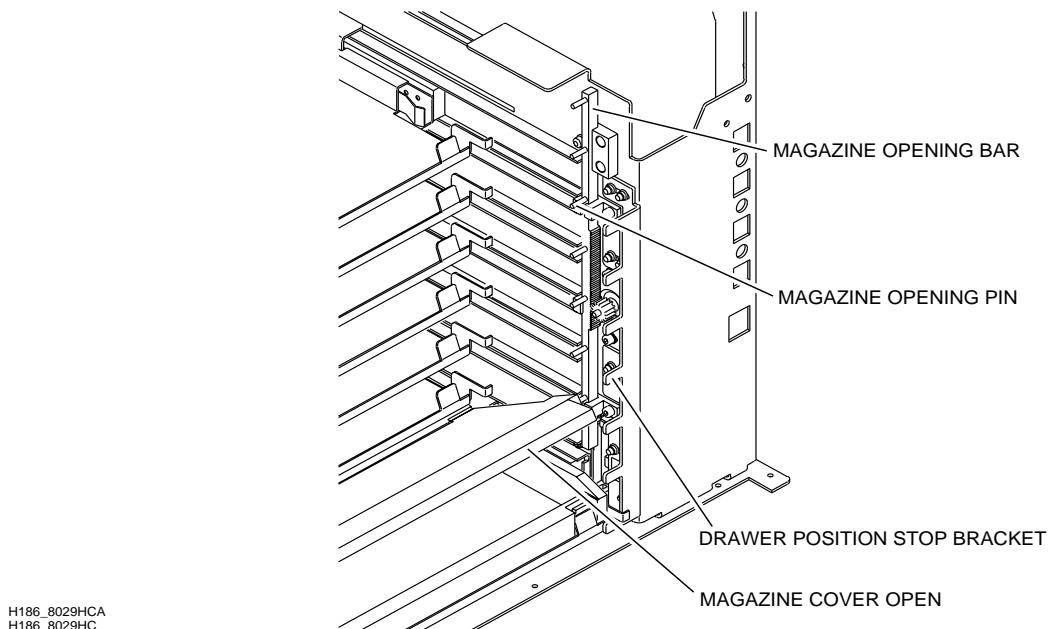
Front View of MAGAZINE SHUTTLE MECHANISM

H186_8025HCA
H186_8025HC

After the MICROPROCESSOR determines the desired film size and type, it selects the appropriate MAGAZINE DRAWER. The TRANSPORT MAGNET adjacent to the selected DRAWER energizes and the MSM pulls the DRAWER into the pick-up position. The TRANSPORT MOTOR energizes to drive a BEVEL GEAR, two PULLEYS and two TIMING BELTS. The TIMING BELTS pull the MAGNET HOLDER BRACKET along two shafts to the pick-up position.



In order to pick-up the film from the MAGAZINE, the MAGAZINE must be positioned precisely. The MSM transports the MAGAZINE DRAWER to the film pick-up location, and two DRAWER positioning STOP BRACKETS stop the film DRAWER in the right location. The MAGAZINE LOCKING MECHANISM, a shaft with seven pins, holds the selected MAGAZINE in position. A SOLENOID energizes a CYLINDER which rotates the SHAFT. One of the seven pins engages a slot in the selected MAGAZINE, and locks the MAGAZINE in place. There is a sensor for the unlocked position only.



To open the MAGAZINE COVER, a stepper MOTOR energizes to drive a GEAR which drives the MAGAZINE OPENING BAR. The BAR has seven MAGAZINE OPENING PINS. One of the PINS is under the COVER of the selected MAGAZINE. As the BAR rises, the PIN lifts the MAGAZINE COVER. There is a SENSOR for both the open and close position which senses a REFLECTIVE STICKER on the side of the MAGAZINE. The locking mechanism is unlocked while the MAGAZINE is opened to allow the pin to get out the way when the MAGAZINE DOOR opens.

FILM CHUTE SYSTEM

The FILM CHUTE guides the exposed film as it moves from the CONVEYOR to the PROCESSOR INTERFACE. The entrance to the film CHUTE is a moveable FUME TRAP. A metal FILM-RELEASE FLAP at the exit of the FILM CHUTE aligns and controls the timing of the film's entrance into the PROCESSOR INTERFACE.

PROCESSOR INTERFACE SYSTEM

The PROCESSOR INTERFACE transports the exposed FILM from the FILM CHUTE to the PROCESSOR. It consists of a FRAME with a FILM GUIDE and 3 pair of transport ROLLERS. The speed of the PROCESSOR INTERFACE is consistent with the speed of the PROCESSOR.

FILM SIZE/TYPE SENSING SYSTEM

The MULTILOADER 7000 determines the size of film required by measuring the CASSETTE. For each size of CASSETTE, two types of film can be selected. If the film Type 2 DETECTION SENSOR reads the presence of a reflective STICKER on the inserted CASSETTE, the MULTILOADER 7000 determines the film is type 2. If the SENSOR does not sense the presence of the STICKER, the film is type 1.

SENSORS also read the MAGAZINES to determine the type and size of film in each MAGAZINE. There is a location for six reflective STICKERS on each MAGAZINE. Six reflective SENSORS read the presence or absence of these STICKERS and determine the size and type of film in each MAGAZINE.

The code for each film type is:

- 1 = STICKER
- 0 = No STICKER

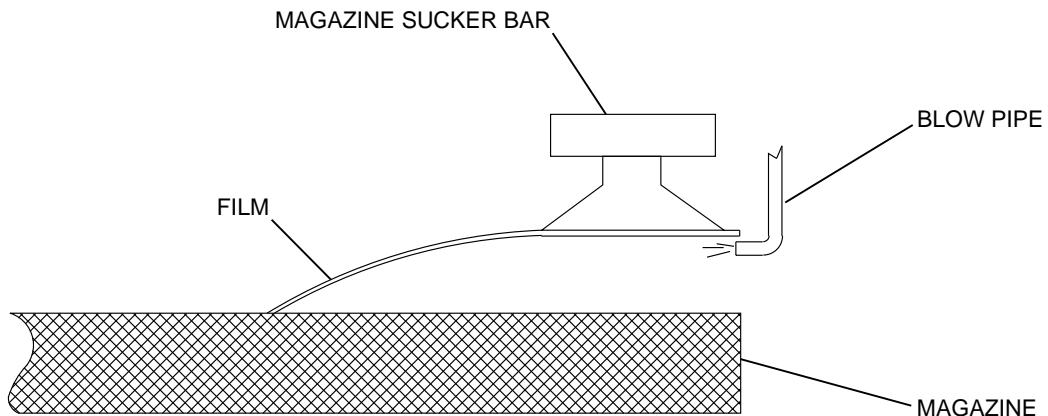
Format	Film Type 1						Film Type 2					
	1	2	3	4	5	6	1	2	3	4	5	6
18 x 24 cm	1	0	0	0	0	0	1	0	0	0	1	0
24 x 24 cm	0	1	0	0	0	0	0	1	0	0	1	0
30 x 35 cm	0	1	1	0	0	0	0	1	1	0	1	0
35 x 35 cm	0	0	1	0	0	0	0	0	1	0	1	0
18 x 43 cm	1	0	0	1	0	0	1	0	0	1	1	0
24 x 30 cm	0	1	0	1	0	0	0	1	0	1	1	0
35 x 43 cm	0	0	1	1	0	0	0	0	1	1	1	0
30 x 40 cm	0	1	1	1	0	0	0	1	1	1	1	0
15 x 30 cm	0	0	0	0	1	0	0	0	0	0	0	1
8 x 10 in. CRT	1	1	0	0	0	0	1	1	0	0	1	0
8 x 10 in.	1	0	1	0	0	0	1	0	1	0	1	0
10 x 12 in.	1	1	1	1	0	0	1	1	1	1	1	0
11 x 14 in.	1	1	1	0	0	0	1	1	1	0	1	0
20 x 40 cm	1	0	1	1	0	0	1	0	1	1	1	0
18 x 24 cm MinR-2	0	0	0	1	0	0	0	0	0	1	1	0
24 x 30 cm MinR-2	1	1	0	1	0	0	1	1	0	1	1	0
No MAGAZINE	0	0	0	0	0	0	0	0	0	0	0	0

FILM POCKET ASSEMBLY SYSTEM

The FILM POCKET ASSEMBLY removes a film from the MAGAZINE, transports it to, and inserts it into the CASSETTE. A SUCKER BAR picks-up the film from the MAGAZINE and pulls it into the FILM POCKET. SENSORS check for empty MAGAZINES or a double film pick. The FILM POCKET moves to the CASSETTE position and inserts the film into the CASSETTE.

PNEUMATIC SYSTEM

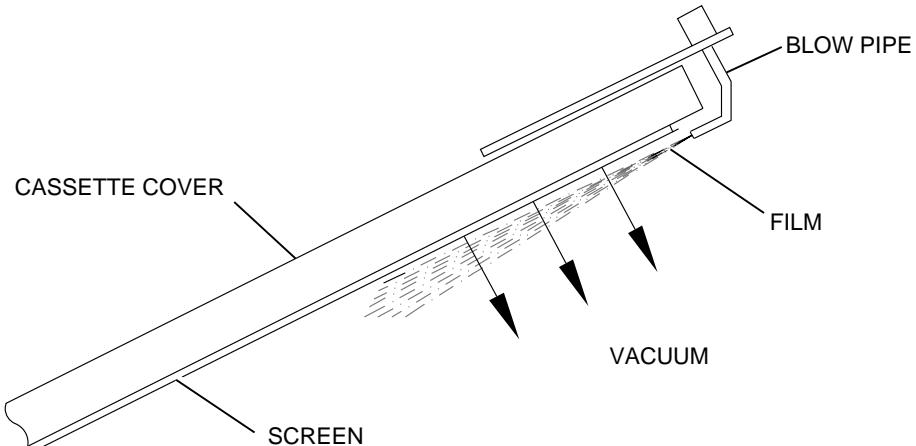
MAGAZINE SUCKER BAR and BLOW PIPE ASSEMBLY



H186_8017BCA
H186_8017BC

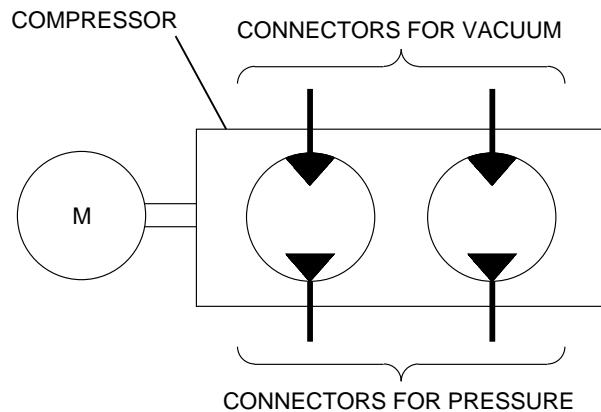
The MAGAZINE SUCKER BAR ASSEMBLY uses vacuum to pick up the top sheet of film from the selected MAGAZINE. The BLOW PIPES blow air against the edge of the film to ensure that a second sheet of film is not sticking to the first sheet.

CASSETTE BLOW PIPE ASSEMBLY



H186_8018BCA
H186_8018BC

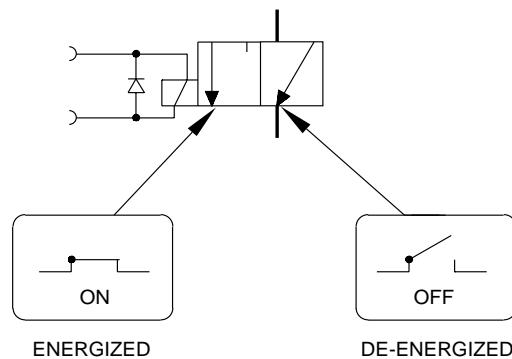
As the CASSETTE COVER opens, the sheet of film frequently sticks to the SCREEN on the underside of the COVER. The BLOW PIPE assembly blows air over the surface of the film to separate the film from the CASSETTE LID. This creates a vacuum above the surface to suck the film from the SCREEN. The BLEEDER VALVE de-energizes the BLOW PIPES when the pressure reaches 4 bars.

FILTERS and WATER TRAPS

H186_8015ACA
H186_8015AC

The COMPRESSOR supplies both vacuum and compressed air.

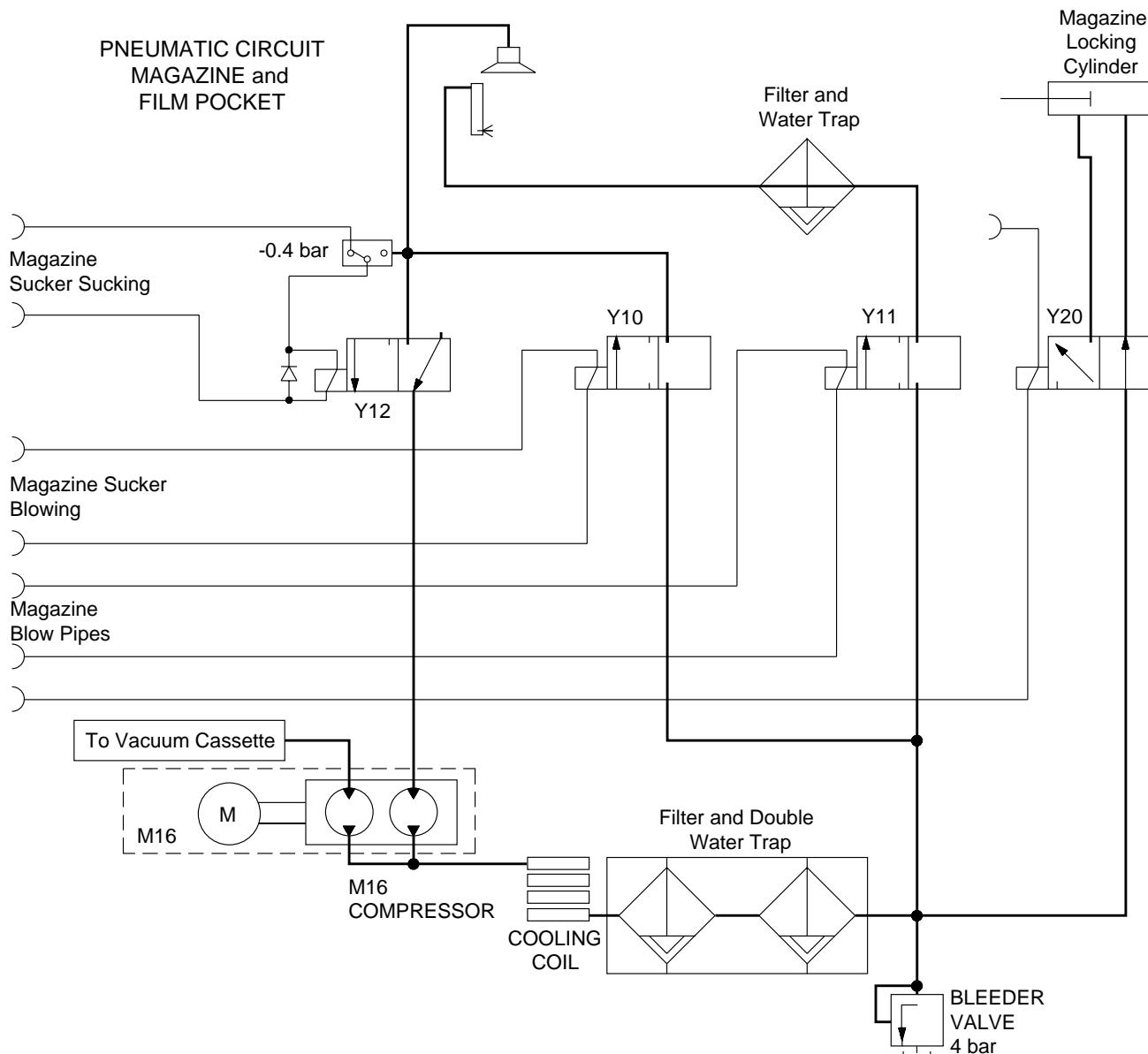
A FILTER with a water trap and a FILTER with a double water trap remove dirt particles and water from the air lines. Moisture and dirt particles can damage the SOLENOIDS and the film.

SOLENOID VALVES

H186_8016AC

The MULTILOADER 7000 has seven SOLENOID VALVES. They energize the two SUCKER BAR ASSEMBLIES, the two BLOW PIPE ASSEMBLIES and the CYLINDER for the MAGAZINE LOCKING PIN. Both the energized and de-energized positions for the SOLENOIDS are shown.

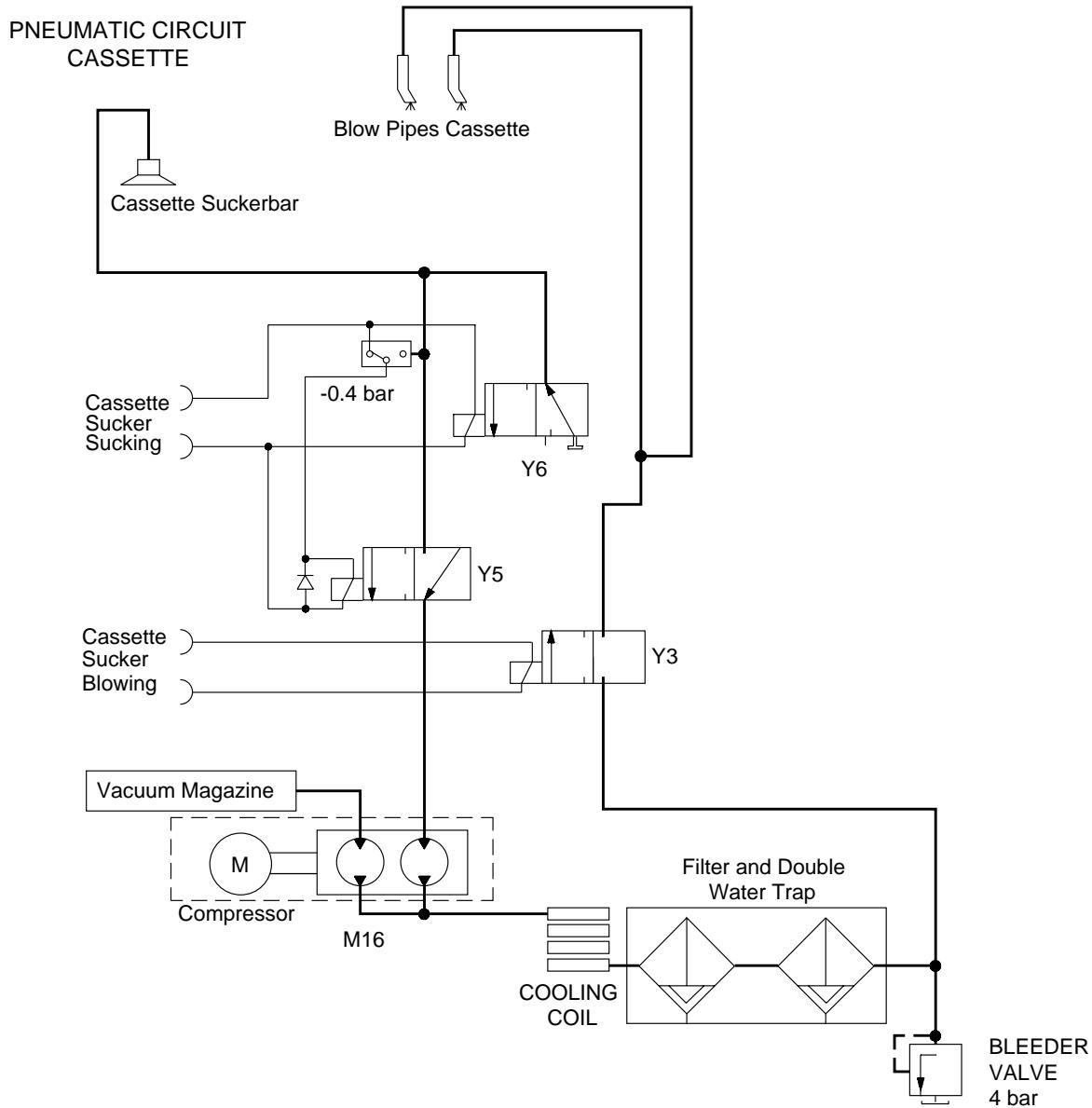
FILM POCKET ASSEMBLY



H186_8014DC

This is the pneumatic operation of the film POCKET ASSEMBLY. SOLENOID Y12 provides the vacuum for the MAGAZINE SUCKER BAR ASSEMBLY, with Y10 providing the venting for the vacuum. SOLENOID Y11 provides the air to the BLOW PIPE ASSEMBLY. SOLENOID Y20 energizes the CYLINDER for the MAGAZINE LOCKING PIN. The FILTERS, water TRAPS and bleeder VALVES are also shown.

CASSETTE SUCKER BAR AND BLOW PIPES



H186_8013DC

SOLENOID Y5 provides the vacuum for the CASSETTE SUCKER BAR ASSEMBLY, with Y6 providing the venting for the vacuum. SOLENOID Y3 provides the air to the BLOW PIPE ASSEMBLY. The FILTERS, WATER TRAPS, and BLEEDER VALVE are also shown.

MOTORS

All AC-MOTORS have an operating voltage of 115 Volts and can be used with 50 Hz or 60 Hz.

INPUT FLAP MOTOR M1

The MOTOR M1 opens and closes the CASSETTE INPUT FLAP. MOTOR M1 is a synchronous MOTOR with an operating voltage of 115 V AC. Two SENSORS detect the position of the CASSETTE INPUT FLAP. SENSOR B3 actuates when the CASSETTE INPUT FLAP opens completely. SENSOR B4 actuates when the CASSETTE INPUT FLAP closes completely.

CASSETTE INPUT MOTOR M2

MOTOR M2 is a DC MOTOR with an operating voltage of 20 V DC. It can operate in forward or reverse. The MOTOR M2 drives the ROLLERS which transport the CASSETTE into and out of the MULTILOADER 7000. The MOTOR energizes when SENSOR B2 on the ROLLER ASSEMBLY at the CASSETTE ENTRANCE detects a CASSETTE. The MOTOR de-energizes when at least two of the three SENSORS B5, B6, B7 at the CASSETTE STOP actuate from the leading edge of the CASSETTE. To eject the CASSETTE, the MOTOR M2 de-energizes a short time after SENSOR B2 detects the CASSETTE at the CASSETTE ENTRANCE. This time is determined by the cassette width:
If the CASSETTE width =< 315 mm, the time before MOTOR M2 de-energizes is 320 msec.
If CASSETTE width > 315 mm, the time before MOTOR M2 de-energizes is 700 msec.

HOLDING FINGER MOTOR M3

MOTOR M3 is a 115 V AC MOTOR that moves the HOLDING FINGER forward and reverse. The ODOMETER B8 measures the width of the CASSETTE by counting the pulses caused by the rotation of the TIMING DISC. SENSOR B8 also detects the home position and the end positions of the HOLDING FINGER. When the HOLDING FINGER reaches the CASSETTE, or one of its mechanical END STOPS, the MOTOR M3 stops and the TIMING DISC stops turning. If the SENSOR reads no pulses for 30 msec, the MULTILOADER 7000 assumes that the HOLDING FINGER is at a mechanical stop and the MOTOR M3 de-energizes.

CASSETTE CENTERING MOTOR M4

MOTOR M4 is a 115 V AC motor that moves the CASSETTE CENTERING BARS in and out. SENSOR B10 detects the CENTERING BARS in the outermost position. SENSOR B9 detects the CASSETTE CENTERING BARS in the innermost position. SENSOR B11 and SENSOR B12 detect that a CASSETTE is clamped between the CASSETTE CENTERING BARS. SENSOR B13 is an ODOMETER that measures the length of the CASSETTE.

CASSETTE OPENING MOTOR M5

MOTOR M5 is a 20 V DC MOTOR that lifts the CASSETTE LID. SENSOR B15 detects when the CASSETTE OPENER is in the uppermost position. SENSOR B14, an ODOMETER measures the position of the CASSETTE OPENER in relationship to the uppermost position.

CASSETTE FILM PICK-UP MOTOR M6

MOTOR M6 is a 116 V AC MOTOR that moves the SUCKER BAR CARRIAGE into the CASSETTE and back to the home position. SENSOR B17 detects the CASSETTE SUCKER BAR in the CASSETTE, and SENSOR B18 detects the CASSETTE SUCKER BAR in the home position.

ROLLER MOTOR M7

MOTOR M7 is a 115 V AC MOTOR that drives the ROLLER TRANSPORT MECHANISM in the CONVEYOR. The MICROPROCESSOR on the BOARD A3 energizes the MOTOR M7 after the vacuum for the CASSETTE SUCKER BAR energizes for the unloading of the CASSETTE. The MOTOR M7 de-energizes when the CASSETTE ejects out of the MULTILOADER 7000.

FILM POCKET STEPPER MOTOR M10

MOTOR M10 is a DC STEPPER MOTOR that moves the FILM POCKET to the different MAGAZINE levels, the CASSETTE level and the home position. SENSORS detects the position of the FILM POCKET.

INTERFACE FLAP MOTOR M11

MOTOR M11 is a 115 V AC MOTOR that opens and closes the FLAP at the entrance of the FILM CHUTE. SENSOR B33 detects the FLAP closed.

CHUTE FILM RELEASE FLAP MOTOR M12

MOTOR M12 is a 115 V AC MOTOR that opens and closes the FILM RELEASE FLAP on the bottom side of the FILM CHUTE. SENSOR B34 detects the FILM RELEASE FLAP closed.

PROCESSOR INTERFACE MOTOR M13

MOTOR M13 is a STEPPER MOTOR that drives the TRANSPORT ROLLERS of the PROCESSOR INTERFACE. The SOFTWARE sets the MOTOR speed to the same speed as the PROCESSOR.

MAGAZINE SUCKER BAR MOTOR M15

MOTOR M15 is a 115 V AC MOTOR that drives the MAGAZINE SUCKER BAR in and out. The SUCKER BAR moves in to take a fresh film from a MAGAZINE and to put the fresh film into the CASSETTE. SENSOR B56 detects the position of the MAGAZINE SUCKER BAR. When the SUCKER BAR is in the retracted position, the FILM POCKET transports it from the MAGAZINE level to the CASSETTE level. SENSOR B58 on the BOARD A5 detects the retracted position. The home position of the SUCKER BAR is between the retracted and the insert position. The SUCKER BAR is in the home position when there is no film on the SUCKERS. SENSOR B57 on the BOARD A5 detects the SUCKER BAR in the home position.

COMPRESSOR MOTOR M16

The MOTOR M16 drives the COMPRESSOR that operates the entire pneumatic system, [see Page 21](#).

MAGAZINE TRANSPORT MOTOR M20

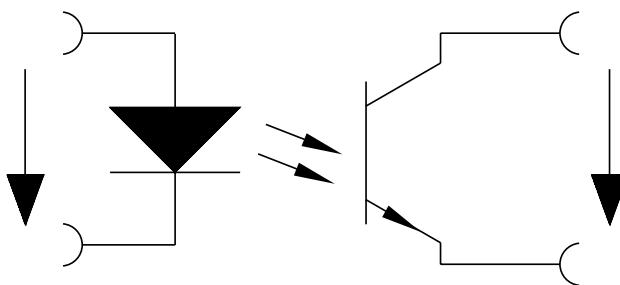
MOTOR M20 is a 20 V DC MOTOR that drives a GEAR, SHAFT and two TIMING BELTS to pull the FILM MAGAZINE into the pick-up position. When the MAGAZINE approaches the film pick-up position, it hits SENSOR B103 and the MOTOR slows the speed until the MAGAZINE actuates the SENSOR B104 for the pick-up position. When the MAGAZINE approaches the home position, it actuates SENSOR B101 and the MOTOR slows speed until the MAGAZINE actuates the MAGAZINE HOME POSITION SENSOR B102.

MAGAZINE OPEN MOTOR M21

MOTOR M21 is a stepper MOTOR that drives the MAGAZINE OPENER BAR to open and close the selected MAGAZINE. SENSOR B106 detects the MAGAZINE OPENER BAR in the MAGAZINE open position, and SENSOR B105 detects the OPENER BAR in the home position.

SENSORS and SWITCHES

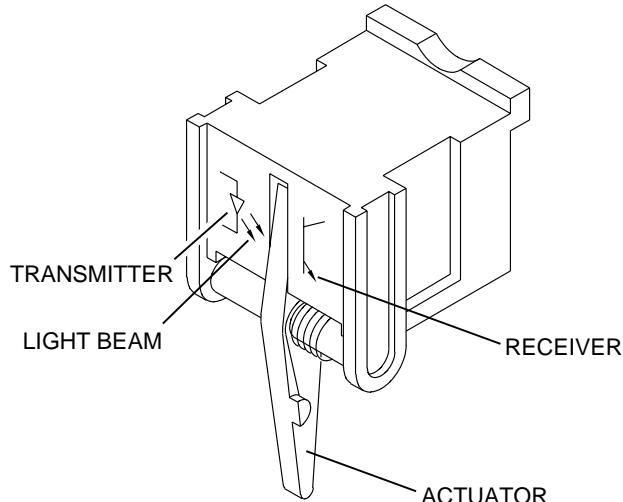
Introduction



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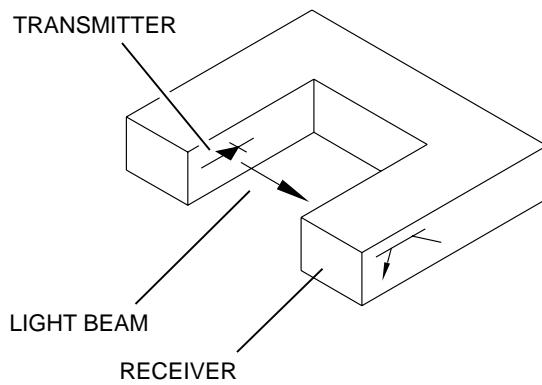
The MULTILOADER 7000 uses several different types of SENSORS. This section describes the different types of SENSORS. The universal symbol represents all SENSORS.

OPTICAL FLAG



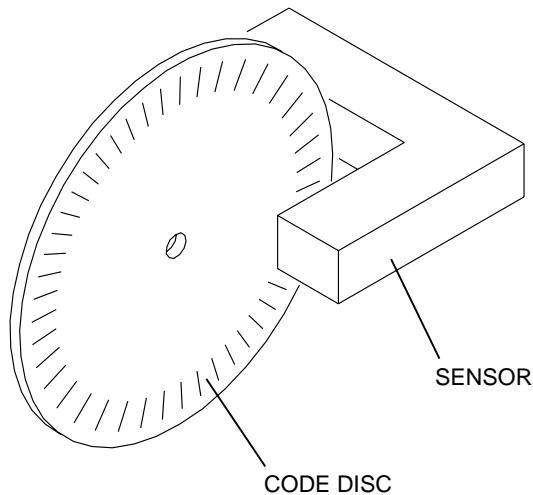
H186_8012ACA
H186_8012AC

The OPTICAL FLAG is a mechanically operated SENSOR in which an ACTUATOR interrupts a LIGHT BEAM. The ACTUATOR is spring loaded. In the non-actuated position the ACTUATOR interrupts the LIGHT BEAM between the TRANSMITTER and the RECEIVER. In the actuated position the LIGHT BEAM from the TRANSMITTER passes to the RECEIVER.

U-shaped LIGHT SENSOR

H186_8008ACA
H186_8008AC

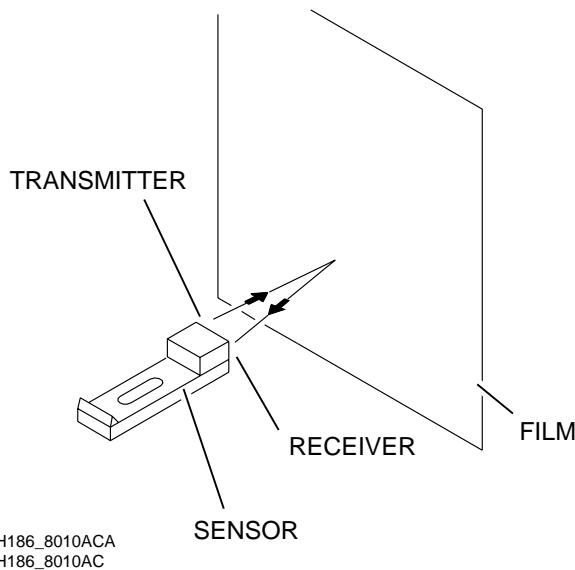
The U-SHAPED LIGHT SENSOR contains both a light TRANSMITTER and a light RECEIVER, and is used in two different applications. In the first application a BRACKET interrupts the LIGHT BEAM to actuate the SENSOR. In the second application a rotating TIMING DISC and the U-shaped LIGHT SENSOR combine to form an ODOMETER to measure distance and to detect mechanical position. See below for ODOMETER.

ODOMETER

H186_8009ACA
H186_8009AC

The ODOMETER detects position by measuring rotations of the CODE DISC in fixed steps. It also detects the direction of the rotation.

REFLECTIVE SENSORS



The REFLECTIVE SENSOR transmits and receives a LIGHT BEAM. When the film is in the correct position, the LIGHT BEAM from the TRANSMITTER reflects back to the RECEIVER. It also detects the presence or absence of a reflective STICKER.

FRONT DOOR SENSOR B1

This mechanical SENSOR detects the front door of the MULTILOADER 7000 closed.

CASSETTE REGISTRATION SENSOR B2

This optical flag SENSOR B2 at the CASSETTE ENTRANCE of the MULTILOADER 7000 detects the CASSETTE as it enters the MULTILOADER 7000.

CASSETTE INPUT FLAP END SWITCH OPEN SENSOR B3

This optical flag SENSOR detects the CASSETTER INPUT FLAP in the open position.

CASSETTE INPUT FLAP END SWITCH CLOSED SENSOR B4

This optical flag SENSOR detects the CASSETTE INPUT FLAP in the closed position.

CASSETTE IN END SWITCH, LEFT, MIDDLE, RIGHT. B5, B6, B7

These three optical flag SENSORS detect the CASSETTE at the CASSETTE STOP. Three SENSORS detect in combination to ensure that the leading edge of the CASSETTE is fully at the CASSETTE STOP, and not skewed. At least two SENSORS must actuate to detect that the CASSETTE is at the CASSETTE STOP.

CASSETTE WIDTH DETECTION B8

This ODOMETER A10/1 measures the CASSETTE width.

CENTER BARS CLOSED END SWITCH, OPENED END SWITCH B9, B10

The optical flag SENSORS B9 and B10 detect the innermost (B9) and the outermost (B10) position of the two CASSETTE CENTERING BAR.

CASSETTE CENTERING LEFT/RIGHT SWITCH B11, B12

These optical flag SENSORS detect that the CASSETTE centers between the CASSETTE CENTERING BARS. The CASSETTE is determined centered only when both SENSORS actuate.

CASSETTE LENGTH DETECTION B13

This U-shaped SENSOR is part of the ODOMETER A10/2. It measures the CASSETTE length.

CASSETTE OPENER POSITION SENSOR B14

This U-shaped SENSOR is part of the ODOMETER A10/3. It detects the middle and the bottom position of the CASSETTE OPENER ASSEMBLY.

CASSETTE OPENER END SWITCH OPEN B15

This optical flag Sensor detects the open position of the CASSETTE OPENER.

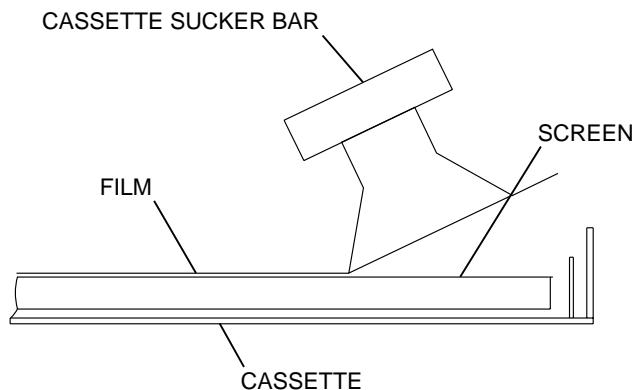
CASSETTE REALLY OPENED SENSOR B16

The open CASSETTE cover actuates this SENSOR. It detects whether the CASSETTE opens after the OPENER ASSEMBLY reaches SENSOR B15.

FILM PICK-UP FRONT/REAR END SWITCHES B17, B18

These two reflective SENSORS detect the front and the rear position of the CASSETTE SUCKER BAR CARRIAGE. SENSOR B17 detects the front position when the sucker bar is located in the cassette. SENSOR B18 detects the rear position when the CASSETTE SUCKER BAR CARRIAGE is in the home position.

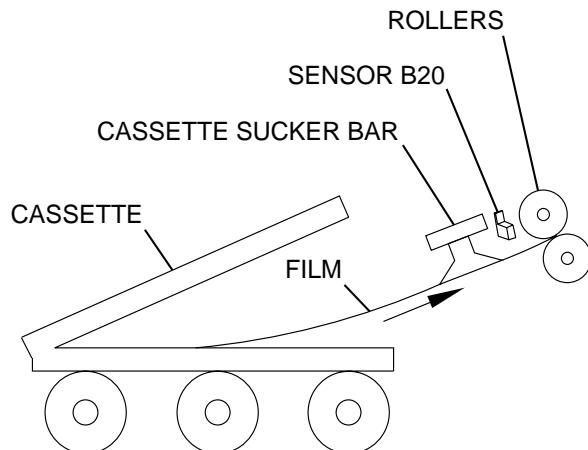
CASSETTE SUCKER BAR TILT B19



H186_8007ACA
H186_8007AC

The optical flag SENSOR detects the CASSETTE SUCKER BAR in the tilt position. The CASSETTE SUCKER BAR tilts to separate the film from the screen in the bottom of the CASSETTE. The SENSOR also detects if there is no film in the CASSETTE. When there is no film in the CASSETTE the CASSETTE SUCKER BAR attaches directly to the SCREEN in the CASSETTE and cannot lift. The MULTILOADER 7000 detects the CASSETTE as empty when SENSOR B19 does not actuate after the tilting of the CASSETTE SUCKER BAR energizes. This function is not used with mammography CASSETTES and video film holders, because there is no SCREEN in these CASSETTES.

VACUUM OFF SENSOR B20



H186_8006ACA
H186_8006AC

This SENSOR is located at the entrance of the CONVEYOR. The signal of SENSOR B20 de-energizes the vacuum of the CASSETTE SUCKER BAR. The CASSETTE SUCKER BAR places the film between the ROLLERS at the entrance of the CONVEYOR before the SUCKER BAR CARRIAGE reaches the rear position. The vacuum on the CASSETTE SUCKER BAR must de-energize before the SUCKER BAR CARRIAGE reaches the rear position, or film jams would occur in the CONVEYOR. The vacuum de-energizes a short time - vacuum-off time - after the leading edge of the film actuates SENSOR B20.

FILM TYPE 2 DETECTION LEFT/RIGHT B21, B22

These two reflective SENSORS are located on the two CASSETTE CENTERING BARS. After the CASSETTE centers, the MULTILOADER 7000 reads SENSORS B21 and B22. If at least one of the SENSORS actuates, the MULTILOADER 7000 detects the CASSETTE as type 2. The sensors detect the presence or absence of a reflective STICKER on the top cover of the CASSETTE.

FILM POCKET HOME POSITION B30, MAGAZINE LEVEL B32

SENSOR B30 detects the home position of the FILM POCKET ASSEMBLY.

SENSOR B32 detects the correct positions of the FILM POCKET at both the MAGAZINE level and the CASSETTE level. This ensures that the MAGAZINE SUCKER BAR can safely move into the MAGAZINE or the CASSETTE.

INTERFACE FLAP CLOSED B33

SENSOR B33 detects the INTERFACE FLAP of the FILM CHUTE closed.

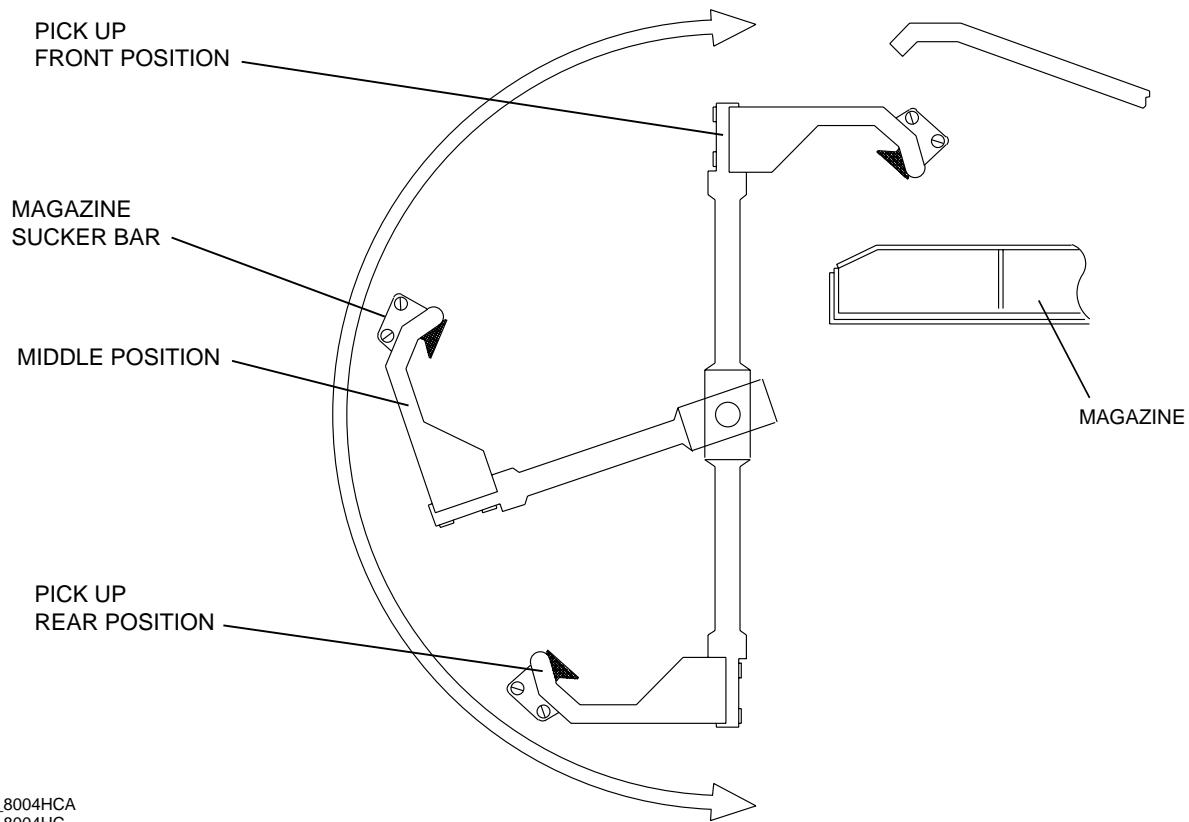
FILM RELEASE CLOSED B34

SENSOR B34 detects the FILM RELEASE of the FILM CHUTE closed.

FILM IN INTERFACE BOTTOM B35

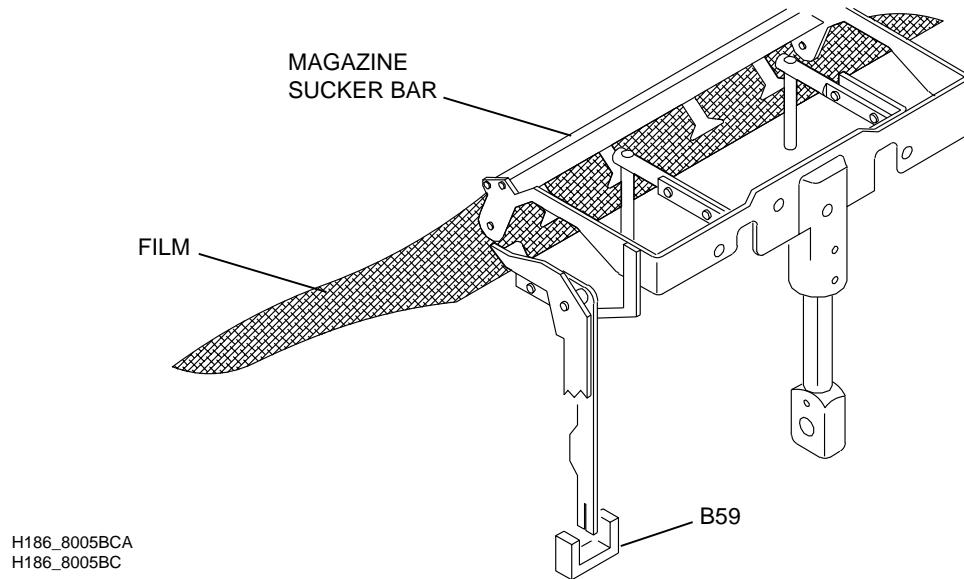
SENSOR B35 detects a film at the FILM RELEASE. SENSOR B35 is the last SENSOR in the MULTILOADER 7000 to detects the exposed film after the unloading of the CASSETTE.

FILM PICK-UP FRONT END SWITCH B56, FILM PICK-UP MIDDLE POSITION B57, FILM PICK-UP REAR SWITCH B58

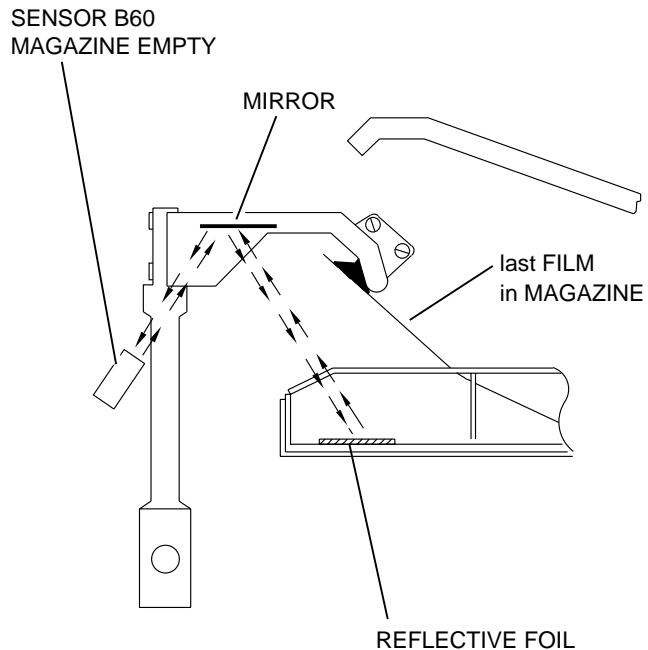


H186_8004HCA
H186_8004HC

These three SENSORS on BOARD A5 detect the three positions of the MAGAZINE SUCKER BAR.

DOUBLE SHEET DETECTOR B59

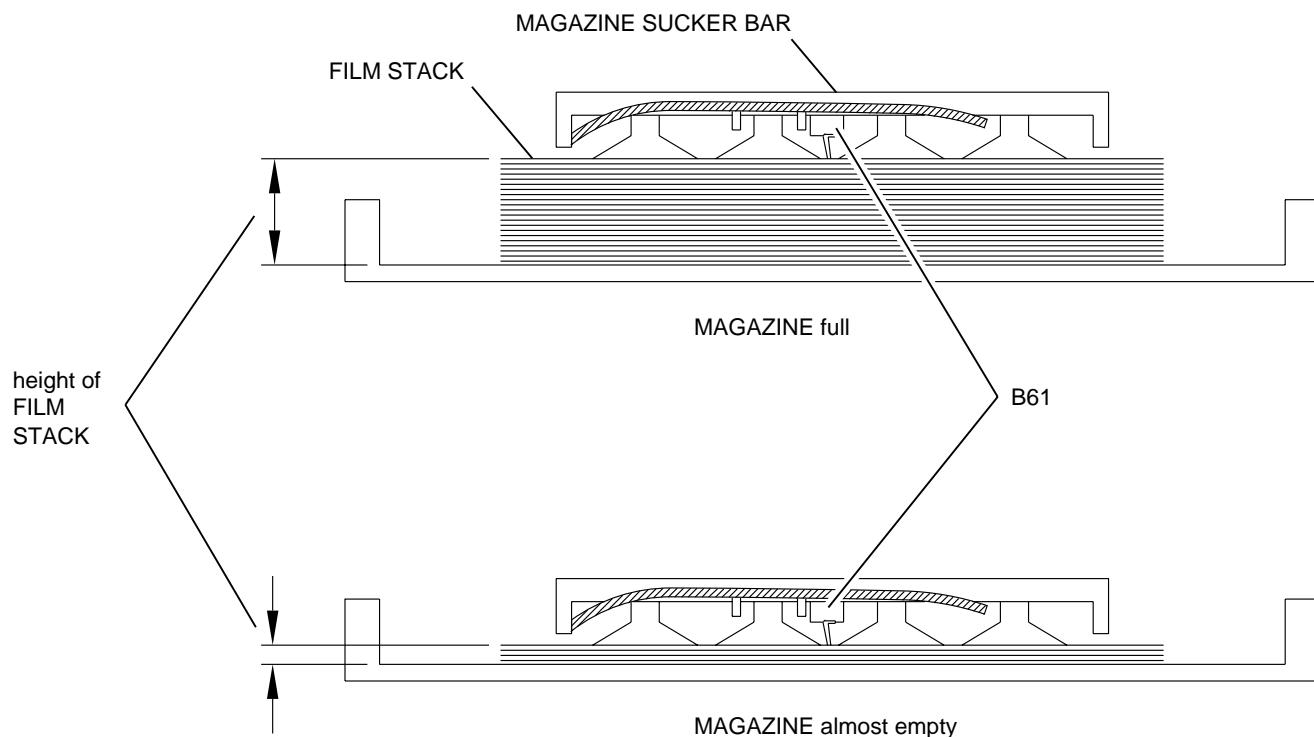
The DOUBLE FILM DETECTOR measures the thickness of film before the MAGAZINE SUCKER BAR exits the MAGAZINE. SENSOR B59 detects the thickness of the film above 0.3 mm (.012 in.) The thickness of one film is approximately 0.2 mm (.008 in.), so the MULTILOADER 7000 assumes that a thickness above 0.3 mm (.012 in.) must be a double film. The MULTILOADER 7000 assumes that a thickness 0.1 mm (.004 in.) or below is no film.

MAGAZINE EMPTY SENSOR B60

H186_8003GCA
H186_8003GC

This reflective SENSOR B60 detects the MAGAZINE empty. The LIGHT BEAM coming from the SENSOR B60 reflects through a MIRROR on the MAGAZINE SUCKER BAR into the MAGAZINE. The MIRROR directs the LIGHT BEAM to a REFLECTIVE FOIL on the bottom of the MAGAZINE. The FOIL reflects the LIGHT BEAM back if there is no film in the MAGAZINE. To insure that SENSOR B60 does not expose the film, it is switched on in pulses to reduce the amount of light. When the MAGAZINE is empty, the FOIL reflects the LIGHT BEAM via a MIRROR back to the SENSOR B60. The SENSOR is read before the MAGAZINE SUCKER BAR moves into the MAGAZINE and when the MAGAZINE SUCKER BAR moves from the pick up front position to the pick up rear position. This enables the MULTILOADER 7000 to detect that a MAGAZINE is empty by removing the last film from the MAGAZINE.

FILM AT SUCKER BAR SENSOR B61



H186_8002HCA
H186_8002HC

SENSOR B61 detects a film at the SUCKER BAR of the film POCKET. Several steps of the cycle of the film POCKET require the output of SENSOR B61.

It detects that the film POCKET SUCKER BAR has reached the film stack in the MAGAZINES. Since the height of the film stack in the MAGAZINES varies there is no fixed position for the FILM POCKET for picking up the film. After moving into the MAGAZINE, the FILM POCKET lowers until SENSOR B61 actuates. The FILM POCKET stops after some additional steps of the stepper MOTOR after SENSOR B61 actuates. The additional steps remove the clearance between the SUCKERS and the film and compensate for the tolerance of the SENSOR.

SENSOR B61 also detects the absence of film at the MAGAZINE SUCKER BAR after it has been blown off into the CASSETTE.

MAGAZINE TRANSPORT CLOSE TO HOME POSITION SENSOR B101

This U-shaped SENSOR detects when the MAGAZINE TRANSPORT is nearing the home position. A BRACKET interrupts the LIGHT BEAM of the SENSOR. The actuation of this SENSOR causes the MAGAZINE TRANSPORT to slow down. The home position is the location where all seven of the MAGAZINES are stored.

MAGAZINE TRANSPORT HOME POSITION SENSOR B102

This U-shaped SENSOR detects the MAGAZINE TRANSPORT in the home position. A BRACKET on the MAGAZINE TRANSPORT interrupts the LIGHT BEAM. The actuation of this SENSOR causes the MAGAZINE TRANSPORT to stop.

MAGAZINE TRANSPORT CLOSE TO FILM PICK-UP POSITION SENSOR B103

This U-shaped SENSOR detects when the MAGAZINE TRANSPORT is nearing the pick-up position. A BRACKET on the MAGAZINE TRANSPORT interrupts the LIGHT BEAM. The actuation of this SENSOR causes the MAGAZINE TRANSPORT to slow down.

MAGAZINE TRANSPORT AT FILM PICK-UP POSITION SENSOR B104

This U-shaped SENSOR detects the MAGAZINE TRANSPORT in the pick-up position. A BRACKET on the MAGAZINE TRANSPORT interrupts the LIGHT BEAM. The actuation of this SENSOR causes the MAGAZINE TRANSPORT to stop in the pick-up position.

MAGAZINE CLOSED SENSOR B105

This U-shaped SENSOR detects the MAGAZINE OPENER BAR in the home position. A BRACKET on the OPENER BAR interrupts the LIGHT BEAM. The actuation of this SENSOR tells the MULTILOADER 7000 that the MAGAZINE is closed.

MAGAZINE OPEN SENSOR B106

This U-shaped SENSOR detects the MAGAZINE OPENER BAR in the cover open position. A BRACKET on the OPENER BAR interrupts the LIGHT BEAM. The actuation of this SENSOR indicates that the MAGAZINE COVER is open.

MAGAZINE FILM LEVEL PRECISE DETECTION SENSOR B107

This reflective SENSOR detects the precise level of film in the MAGAZINE. It is located on the film pick-up MECHANISM and is used in conjunction with SENSOR B3.

MAGAZINE LOCKING CYLINDER HOME POSITION SENSOR B108

This SENSOR detects the home or unlocked position of the MAGAZINE LOCKING CYLINDER. There is no SENSOR to detect the locked position.

MAGAZINE DOOR INTERLOCK SENSOR B109

This SENSOR detects whether the MAGAZINE DOOR closes or not.

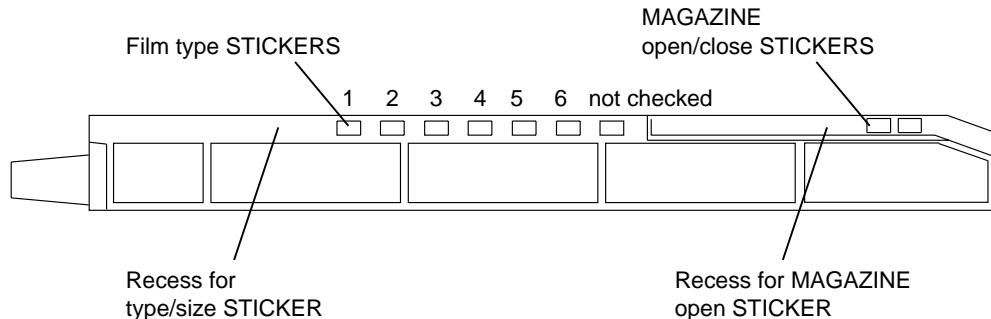
MULTILOADER 7000 COVER CLOSED SENSOR B110

This SENSOR detects whether the COVER of the MULTILOADER 7000 closes or not.

MAGAZINE CLOSED SENSOR B111-1, B111-2, B111-3, B111-4, B111-5, B111-6, B111-7

The B111 Reflective SENSOR reads the presence or absence of a reflective STICKER and determines whether the MAGAZINE COVER is closed. There are seven different B111 SENSORS, one for each of the seven MAGAZINE locations. These SENSORS are located on the BOARD A21 along with SENSOR B112 through B117.

FILM SIZE AND TYPE RECOGNITION SENSORS B112, B113, B114, B115, B116, B117



H186_8001BCC
H186_8001BC

On the edge of each MAGAZINE, there are 7 different locations where a reflective STICKER could be present. Only the first 6 are used. Six reflective SENSORS read for the presence or absence of these

STICKERS. The combination of these SENSOR readings tell the MULTILOADER 7000 which film type and size is located in each MAGAZINE. All six SENSORS are located on BOARD A21 along with the MAGAZINE CLOSED SENSOR. There is an BOARD A21 for each of the seven MAGAZINE locations. The table shows the code for reading the film size and type.

- 1 = STICKER
- 0 = no STICKER

Format	Film Type 1						Film Type 2					
	1	2	3	4	5	6	1	2	3	4	5	6
18 x 24 cm	1	0	0	0	0	0	1	0	0	0	1	0
24 x 24 cm	0	1	0	0	0	0	0	1	0	0	1	0
30 x 35 cm	0	1	1	0	0	0	0	1	1	0	1	0
35 x 35 cm	0	0	1	0	0	0	0	0	1	0	1	0
18 x 43 cm	1	0	0	1	0	0	1	0	0	1	1	0
24 x 30 cm	0	1	0	1	0	0	0	1	0	1	1	0
35 x 43 cm	0	0	1	1	0	0	0	0	1	1	1	0
30 x 40 cm	0	1	1	1	0	0	0	1	1	1	1	0
15 x 30 cm	0	0	0	0	1	0	0	0	0	0	0	1
8 x 10 in. CRT	1	1	0	0	0	0	1	1	0	0	1	0
8 x 10 in.	1	0	1	0	0	0	1	0	1	0	1	0
10 x 12 in.	1	1	1	1	0	0	1	1	1	1	1	0
11 x 14 in.	1	1	1	0	0	0	1	1	1	0	1	0
20 x 40 cm	1	0	1	1	0	0	1	0	1	1	1	0
18 x 24 cm MinR-2	0	0	0	1	0	0	0	0	0	1	1	0
24 x 30 cm MinR-2	1	1	0	1	0	0	1	1	0	1	1	0
No MAGAZINE	0	0	0	0	0	0	0	0	0	0	0	0

Electronic System

POWER SUPPLY

The POWER SUPPLY consists of the BOARD A0, two TRANSFORMERS, two RELAYS, a RECTIFIER, an EMI-FILTER, two INTERLOCK SWITCHES and several FUSES. The POWER SUPPLY adapts to different voltages by a change of wiring at the TRANSFORMERS. The BOARD A0 contains the bulk RECTIFIER and FILTER for the DC voltages, and RELAYS to control the INTERLOCK circuits.

The outputs of the POWER SUPPLY are 10 V DC, 30 V DC and 110 V AC (50/60 Hz). The POWER SUPPLY does not regulate the DC voltages. The DC voltages are distributed throughout the MULTILOADER 7000 and are regulated on the CIRCUIT BOARDS as necessary. Distribution of the DC voltages in this way reduces the susceptibility of the electronics to electrical noise.

The INTERLOCK SWITCHES, along with the BOARD A0 and RELAY K2 control the 110 V AC and 30 V DC for safety. The MAIN POWER SWITCH S1 energizes the RELAY K1 which energizes the MULTILOADER 7000 and the PROCESSOR. As soon as the MULTILOADER 7000 is connected to the AC line, the FAN for venting the MULTILOADER 7000, the 24 V AC CIRCUIT for the INTERLOCK SWITCHES and MAIN POWER SWITCH S1 energize.

BOARDS

MAIN MICROPROCESSOR BOARD A1

A1 is the main MICROPROCESSOR BOARD. The following parts are installed on the BOARD:

An 80C188 MICROPROCESSOR

The 80C188 MICROPROCESSOR has an external 8-bit DATA BUS and an internal 16-bit DATA BUS. It drives all inputs, outputs and programs on the BOARD, and it has an integrated interrupt controller that generates an interrupt hierarchy for the peripheral CIRCUITS which communicate with the MICROPROCESSOR. It also has a WAIT STATE GENERATOR for adapting the MICROPROCESSOR to the response time of peripheral CIRCUITS, a QUARTZ CLOCK GENERATOR with the frequency of 16 MHz, an address decoder to select the RAM-, E- PROM, and three TIMER CIRCUITS.

Two FLASH E- PROMS

The FLASH E-PROMS are erasable/programmable components which store program data. The FLASH E-PROMS are programmable only in total. That means it is only possible to erase all data in the FLASH E- PROMS at once to enable the circuit to be reprogrammed. Except for the function explained above, the FLASH E- PROMS work similar to E- PROMS and PROMS.

A RAM Section

The RAM stores parameters or performance data, such as failures and cycle count.

A BATTERY

The BATTERY back-ups the RAM memory. When the MULTILOADER 7000 de-energizes, the BATTERY supplies the RAM with the voltage needed to maintain the memory. The life of the BATTERY is approximately seven to ten years. In parallel to the BATTERY is a CAPACITOR which can also supply the RAM with the voltage needed to keep the data. A charged CAPACITOR can store the voltage needed for the memory for several hours. This allows time to change the BATTERY.

A REAL TIME CLOCK TIMER

The CLOCK TIMER sends data to the CLOCK that displays the time and the date.

A PARALLEL INTERFACE

The PARALLEL INTERFACE allows communication between the DISPLAY and the USER KEYBOARD.

Four RS 232 SERIAL INTERFACES

Two INTERFACES are for the two SLAVE PROCESSORS. The third INTERFACE is for communication with the PROCESSOR. The fourth INTERFACE is for the communication with the LAPTOP COMPUTER. The communication between the MICRPROCESSOR and the RS 232 INTERFACES is through interrupt routines. All the INTERFACES have DRIVERS installed between the MICROPRESSOR and the output.

A VOLTAGE REGULATION

For a description of the POWER SUPPLY, [see Page 38](#).

One E- PROM

The E- PROM contains the bootstrap software of the MICROPRESSOR. The following routines are on the E-PROM:

- Communication between RS 232 INTERFACES
- Communication between the PARALLEL INTERFACES
- Programming of the FLASH E- PROMS

OPERATOR INTERFACE BOARD A2

The BOARD A2 is the interface between the MAIN PROCESSOR BOARD A1 and the KEYBOARD DISPLAY on the FRONT PANEL of the MULTILOADER 7000.

This BOARD contains three bi-directional DRIVER CIRCUITS to decouple the DISPLAY and the KEYBOARD from the MICROPRESSOR BOARD, and an adjustable DC/AC CONVERTER. This device converts 5 V DC to approximately 450 V AC. The V AC is used to adjust the backlight of the DISPLAY. A DC/DC CONVERTER generates from + 5 V DC to 15 V DC for the contrast of the DISPLAY. This is adjustable by a POTENTIOMETER. It also contains a VOLTAGE REGULATOR, an adjustable BUZZER, and a circuit to dim the DISPLAY BACKLIGHT and LAMPS.

MAGAZINE INTERFACE BOARD A4

The A4 MAGAZINE INTERFACE BOARD controls all the inputs and outputs of the MAGAZINE and film handling MODULES, such as the SENSORS, SWITCHES, MOTORS and SOLENOIDS. It also controls the MAGAZINE SHUTTLE MECHANISM through an RS232 interface.

The BOARD includes:

- A CONTROL CIRCUIT (FPGA) that is based on an 8-bit Infineon C151C MICROPRESSOR with a 128 kByte EPROM that contains the boot software, a 128 kByte Flash-memory that holds the operating Software, and a 128 kByte SRAM - volatile memory.
- A PROGRAMMABLE LOGIC ARRAY that builds the INTERFACE between the controller and the inputs/outputs, configures the MEMORY MAP for the CONTROLLER, and contains the signal processing logic for FILM IN INTERFACE BOTTOM SENSOR B35 and the CLOCK CONTROL for the INTERFACE MOTOR M13. The FPGA gets its program from a SERIAL PROM after each power up of the MULTILOADER 7000.
- DRIVERS/COMPARATORS, and OPTO-COUPPLERS for the input/output signals.
- DIP SWITCHES to change memory maps and software functions.
- A MULTIPLEXER to select between 7 BOARDS A21.
- A PARALLEL INTERFACE to the BOARD A5.
- VOLTAGE REGULATORS.
- A SERIAL INTERFACE to the MAGAZINE SHUTTLE MECHANISM.

FILM POCKET BOARD A5

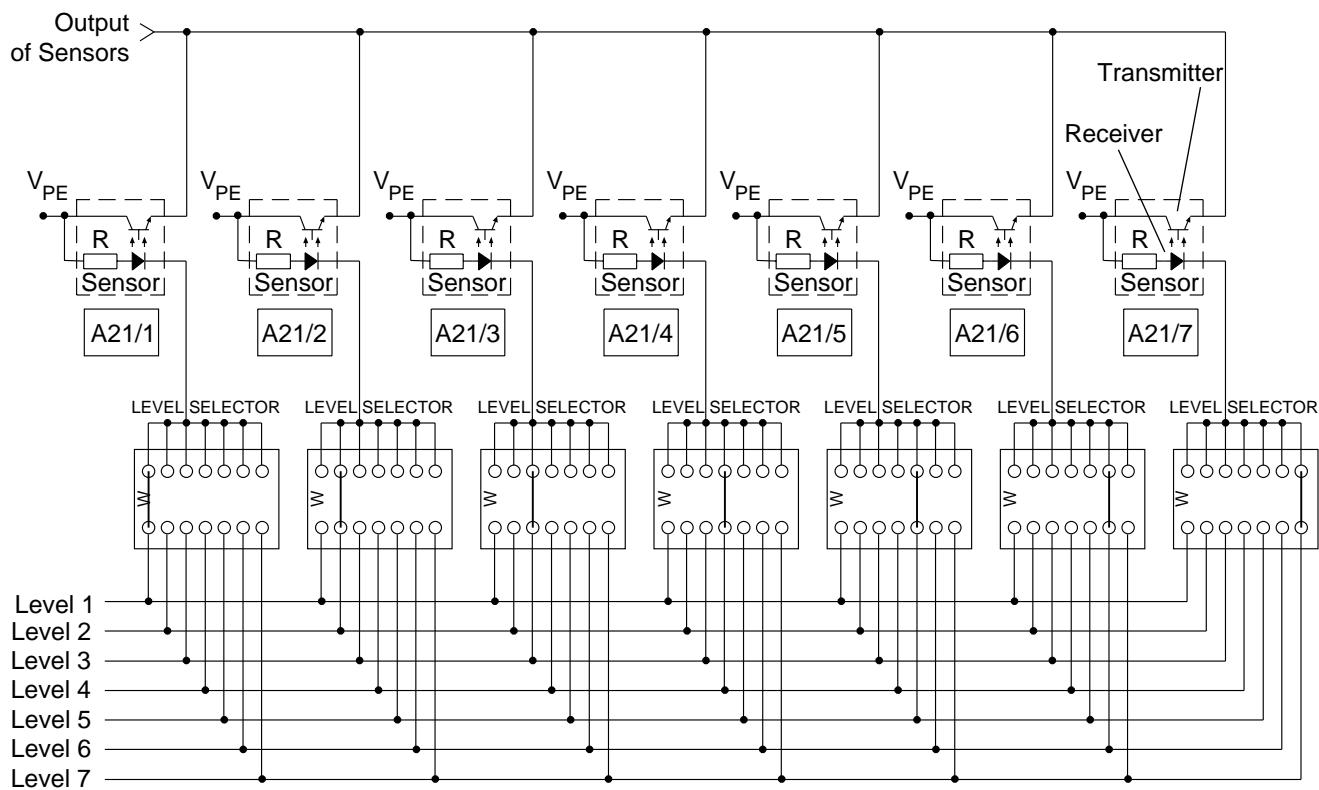
The BOARD A5 is located on the FILM POCKET. It has an internal 24 V REGULATOR to drive the SOLENOIDS. The BOARD A4 supplies 5 V so the BOARD A5 needs no voltage regulation.

The FILM POCKET SUCKER BAR POSITION SENSORS B56, B57 and B58 are on the BOARD A5. The SENSOR signals from the BOARD A7 feed through the BOARD A5. All the signals from the SENSORS are connected to operational AMPLIFIERS to compensate for electrical noise and to determine the high level for the output of the SENSORS for voltages above 2.5 V and the low level for voltages below 2.5 V.

This BOARD energizes or de-energizes the MAGAZINE EMPTY SENSOR B60. The integrated PIC CIRCUIT together with its external components controls the current for the MAGAZINE SUCKER BAR TILT SOLENOID Y14.

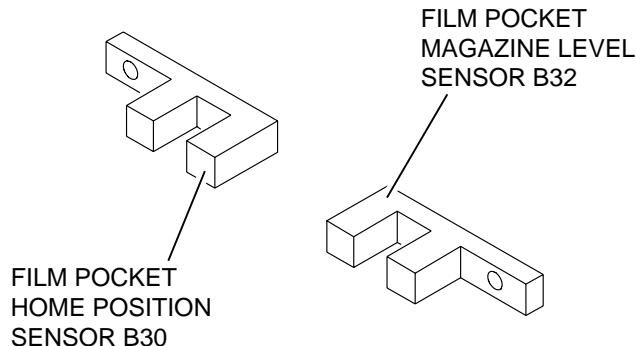
MAGAZINE BOARD A21/1-7

There are seven BOARDS A21 in the MULTILOADER 7000. The BOARD A21 determines the size and type of the film MAGAZINES in the MULTILOADER 7000. The BOARDS A21 also contain the SENSOR for the MAGAZINE COVER. The output of the signals from the seven BOARDS A21 are in parallel to each other.



Only one BOARD A21 is active at any given time. The multiplexing of the seven BOARDS A21 is done by a signal at the CATHODES of the TRANSMITTER DIODES of the SENSORS. As long as there is a high signal at the CATHODES of the TRANSMITTER DIODES, the RECEIVER TRANSISTOR de-energizes whether the SENSOR is interrupted or not. By switching the voltage at the CATHODES of the TRANSMITTER DIODES to ground, the SENSORS on the selected BOARD A21 activate. Since the layout of the seven BOARDS A21 are the same there is a LEVEL SELECTOR necessary to determine the level of the BOARD.

LEVEL CONTROL BOARD A7



H186_8019ACA
H186_8019AC

This BOARD contains only the FILM POCKET HOME SENSOR B30 and the FILM POCKET MAGAZINE LEVEL SENSOR B32.

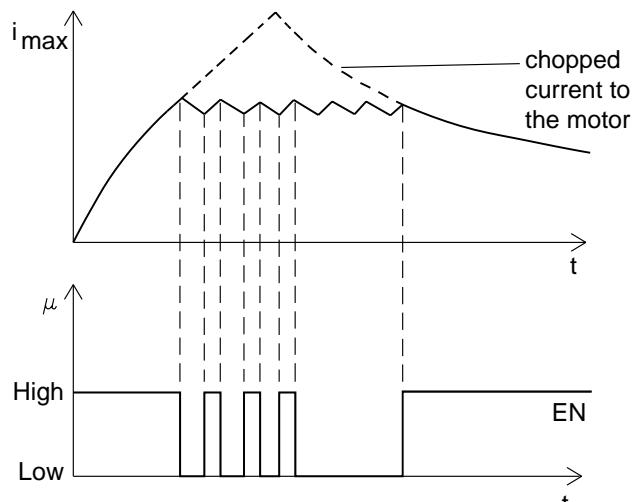
CASSETTE INTERFACE BOARD A8

The A8 BOARD controls all inputs/outputs (SENSORS, SWITCHES, MOTORS and SOLENOIDS) of the CASSETTE MODULE. It includes:

- A CONTROL CIRCUIT based on an 8-bit Infineon C151 MICROPROCESSOR with a 128 kByte EPROM that holds the boot software, a 128 kByte FLASH MEMORY that holds the operating software, and a 128 kByte SRAM (volatile memory).
- A PROGRAMMABLE LOGIC ARRAY (FPGA) that holds the INTERFACE between the CONTROLLER and the inputs/outputs, configures the MEMORY MAP for the CONTROLLER, and contains the signal processing logic for the VACUUM OFF SENSOR B20. The FPGA gets its program from a SERIAL PROM after each start up of the MULTILOADER 7000.
- DRIVERS/COMPARATORS and OPTO COUPLERS for each input and output signal.
- CURRENT LIMITATION/CONTROL CIRCUITS for SOLENOIDS Y4 and Y7.
- DIP SWITCHES to change MEMORY MAPS and software functions.
- VOLTAGE REGULATORS.
- HUMIDIFIER CONTROL CIRCUITS.

DC MOTOR DRIVER BOARD A9

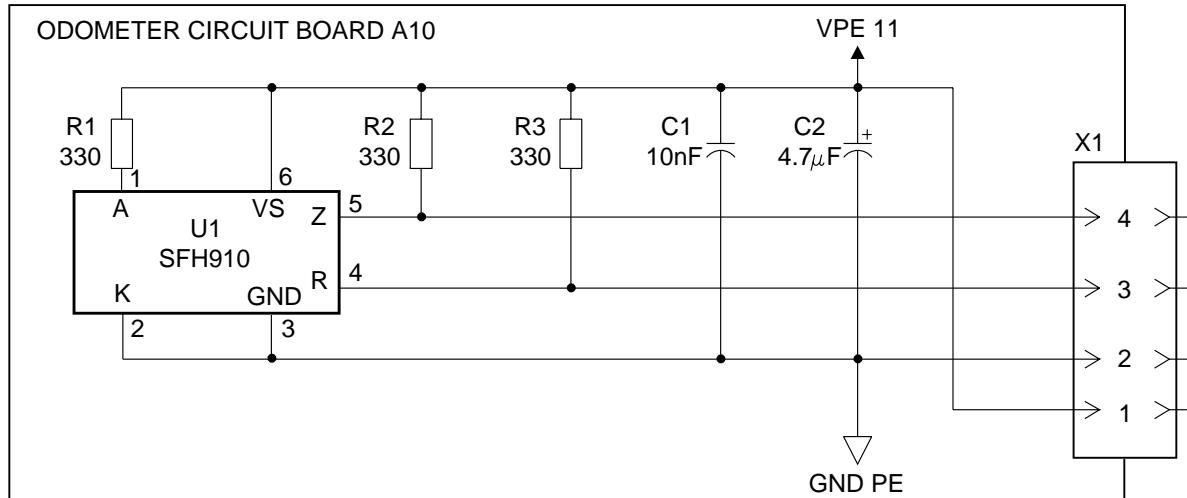
The BOARD A9 controls the two DC MOTORS, CASSETTE OPENING MOTOR M5, and the CASSETTE INPUT MOTOR M2. The circuits on this BOARD also regulate the current through the DC MOTORS. If the current exceeds a certain limit the MOTOR de-energizes. The MOTOR energizes a short time after this.



H186_8021AC

The DRIVER CIRCUIT L6203 is identical to the FILM POCKET STEPPER MOTOR CONTROLLER on the BOARD A4. The signals at PIN 11 (EN = enable of the L6203) and PIN 10 (SNS = output of the sensed value of MOTOR current) are used to limit the current when the MOTORS energize. The additional circuits LM339 and 74LS221 determine the maximum current and the off-time for the chopping during current regulation. The operational AMPLIFIER LM339 acts as a comparator for the determination of the maximum current. The CIRCUIT 74LS221 determines the off-time during the chopping of the output of the DRIVER L6203.

ODOMETER BOARD A10/1-3



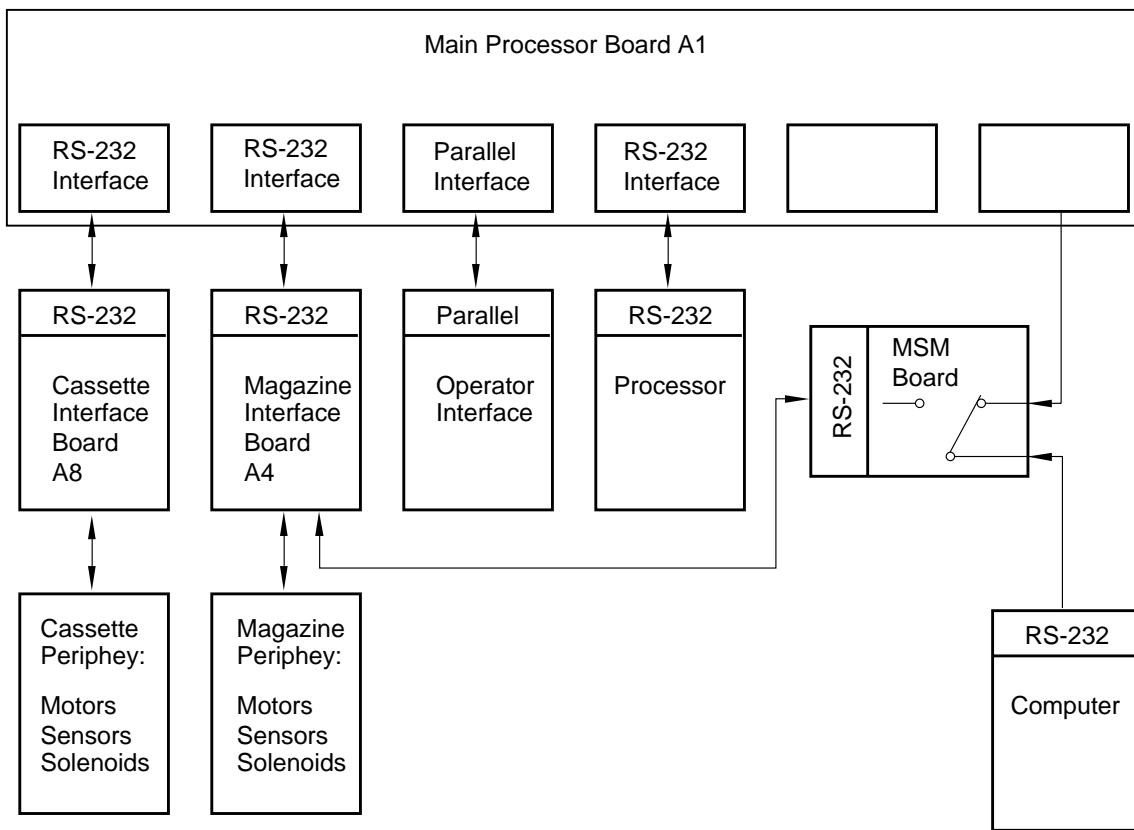
H186_8020BC

The three BOARDS A10 contain the ODOMETERS that measure the CASSETTE length and width and the position of the CASSETTE OPENER. The IC SFH910 contains a SENSOR and a CIRCUIT to detect the direction and rotation of the TIMING DISC.

Software

Introduction

To understand the structure of the software it is very helpful to know something about the basic structure of the hardware.



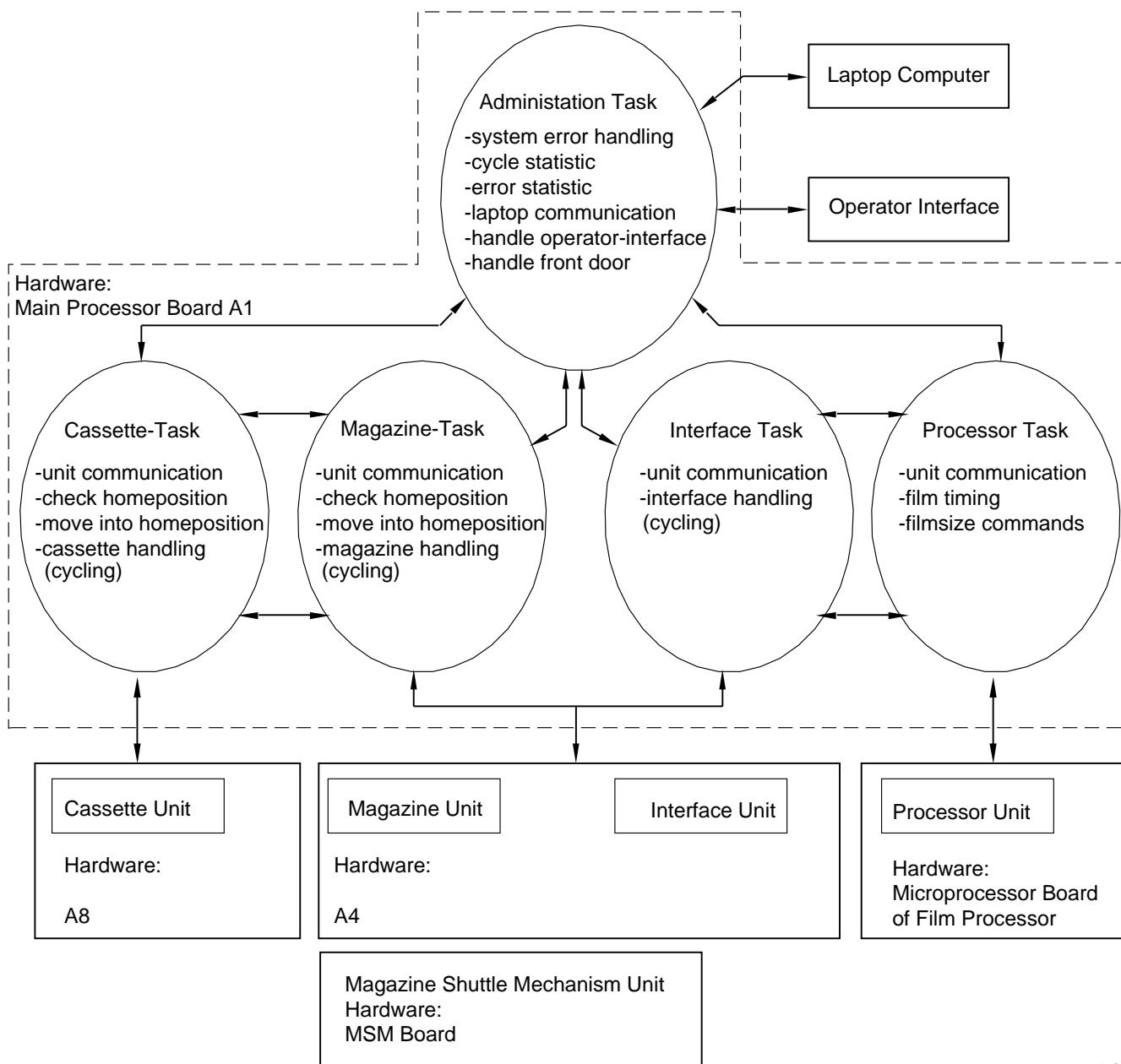
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The MAIN PROCESSOR BOARD A1 controls the MULTILOADER 7000. This BOARD communicates with the CASSETTE INTERFACE BOARD A8, the MAGAZINE INTERFACE BOARD A4, the OPERATOR INTERFACE, the PROCESSOR, the MAGAZINE SHUTTLE MECHANISM BOARD, and the LAPTOP COMPUTER. The BOARD A1 controls all synchronization of the different MICROPROCESSOR BOARDS. The BOARD A1 controls many TASKS which operate simultaneously.

The BOARD A1 does not communicate directly with the MAGAZINE SHUTTLE MECHANISM. Each command for the MSM passes through the MAGAZINE UNIT, and the MAGAZINE UNIT communicates with the MSM unit and controls the commands.

System Tasks

Diagram of System Tasks



Administration Task

The Administration Task controls the MULTILOADER 7000 system, and the OPERATOR INTERFACE. It controls the complete MULTILOADER 7000 in case of any error or failure of the system, and communicates with all the other TASKS, and the LAPTOP COMPUTER with events and mailboxes.

CASSETTE

This Task controls the functions for the CASSETTE. The CASSETTE TASK communicates with the Administration TASK, MAGAZINE TASK, and the INTERFACE UNIT TASK with events and mailboxes.

The CASSETTE TASK initiates any error that occurs in the function of the CASSETTE UNIT.

MAGAZINE

This TASK controls the MAGAZINE UNIT. It communicates with the CASSETTE and ADMINISTRATION TASK with events and mailboxes. The MAGAZINE TASK initiates any error that occurs in the MAGAZINE UNIT before the ADMINISTRATION TASK takes control of the complete system.

INTERFACE

The INTERFACE TASK controls the FILM CHUTE and the PROCESSOR INTERFACE. The INTERFACE TASK communicates with the CASSETTE and the ADMINISTRATION TASK with events and mailboxes. The INTERFACE TASK initiates any failure in the FILM CHUTE or the PROCESSOR INTERFACE.

PROCESSOR

The PROCESSOR TASK controls the PROCESSOR. It communicates with the CASSETTE, INTERFACE, and ADMINISTRATION TASK with events and mailboxes. The PROCESSOR TASK initiates any error that occurs in the PROCESSOR.

Units

The TASKS control all four UNITS in the MULTILOADER 7000 as well as the OPERATOR INTERFACE and the connection to the LAPTOP COMPUTER. The software for the four units is located on three MICROPROCESSOR BOARDS. The programs for the UNITS are split into functions which are controlled by the corresponding TASKS. The routines work on the lowest level of the software. The functions energize and de-energize the MOTORS, and SOLENOIDS, and they monitor the SENSORS and create error message.

LAPTOP COMPUTER

The LAPTOP COMPUTER is not a part of the MULTILOADER 7000, but it is a useful diagnostic tool for trouble shooting and adjustment. The LAPTOP COMPUTER communicates via a RS232 INTERFACE with the MULTILOADER 7000. It can be used to:

- Store statistics on hard DISC
- Display statistics
- Monitor SENSOR signals
- Energize COMPONENTS
- Check COMPONENTS
- Troubleshoot

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